SCIENTIFIC AMERICAN SUPPLEMENT. No 1105

Scientific American, established 1845.
Scientific American Supplement. Vol. XLIII. No. 1105.

NEW YORK, MARCH 6, 1897.

Scientific American Supplement. $5 a year.
Scientific American and Supplement. $7 a year.

A PARSEE FUNERAL IN INDIA.

FAMINE AND PLAGUE IN INDIA.

FOR a few weeks back the newspapers have been full of accounts of the frightful ravages of the bubonic plague in Bombay and the adjacent seaport towns, but aside from its name and the suggestion of its fatality, no real conception of its horror can be obtained until illustrations were obtained from the plague stricken country. The plague is historically known as a deadly pestilence which was once almost stamped out under the progress of the modern sanitary measures, until four years ago, when it suddenly broke out at Askabad and carried off 1,303 people out of a population of 30,000, and subsequently broke out in Hong-Kong.

Dr. T. C. Craig, surgeon of the United States navy, gives the following particulars as to the spread of the plague:

"As to how individuals contract bubonic plague, no satisfactory answer has as yet been given, but several theories have been formed. Wherever the pestilence has appeared, it has first been noted that vast numbers of dead rats have been seen about the houses. This was particularly true in Hong-Kong. Soon after this, individuals began to die. One explanation advanced was to the effect that some cases of the plague produced death; the rats infesting the premises being half starved, ravenously attack and devour the corpse; the rats then sicken and die; their carcasses in turn were eaten by ants, and the ants in their pilgrimages to and from the food closets carried and deposited the poison on the food, which was in turn consumed by members of the family who were thus infected. This explanation, while ingenious, is not fully tenable, for the reason that the Chinese are invariably particular about the cleanliness and burial of their dead. If there is anything in this rodent theory, it is due to the fact that the people were careless about throwing soiled dressings and discharges where the rats could find and devour them. It is more than probably true that the food and water supply became contaminated from faulty sanitary surroundings and a disregard of the common and ordinary rules of cleanliness.

"The disease is readily disseminated by inoculation, as was shown in the case of one of Kitasato's assistants in Hong-Kong, who, while performing an autopsy upon a plague victim, accidentally inflicted a slight wound, with the result that he developed a case of bubonic plague, which came very nearly costing him his life.

"How does the plague travel? No disease is able to travel from place to place of its own volition. There is no exception to this rule. In studying the areas visited by the bubonic plague, one is not surprised to find that its course from place to place has followed the routes of greatest travel, spreading locally in its way to adjacent towns and villages. We are, therefore, justified in concluding that the plague never appears in any place spontaneously, or without having been transported thither by human agency.

"Persons ill with the disease, or who are recovering from it—for it is dangerous even three or four months after a patient has apparently recovered—infected merchandise, clothing, conveyances, food or water supply—all directly aid in spreading the germs of this terrible malady. No traveler who has visited China or India can have failed to observe the filthy ways and careless customs universal among the natives, who both bathe and wash their clothing in the streams from which their water supply is obtained. It is not difficult in such cases to determine how the entire water supply may become infected, and, therefore, how the infection of countless thousands will surely follow."

Contributions have been sent to India from all over the world; there are 1,750,000 people employed on the government relief works. Reports of former years have shown that few of the natives die of actual starvation in their own village homes; the greatest difficulty is caused by great numbers of them wandering about to other districts where they are strangers and where no preparation can be made for their support. This migration of ignorant and helpless people throws into confusion the local arrangements for kitchens and hospitals provided by the government, and the task of administering relief would be almost impossible were it not for the extension of the roads and canals and railways effected within thirty years past.

The Parsee mode of disposing of the dead is peculiar. The teaching of Zoroaster prohibited the defiling of fire, earth and water, and on this account bodies cannot be burned or buried, or even thrown in the water, as the Hindoos are in the habit of doing with partly burned corpses. The subject of the Parsees' disposal of the dead is so interesting that we republish a description of a Parsee funeral and Tower of Silence from the SCIENTIFIC AMERICAN SUPPLEMENT, No. 925. The information was supplied us by a Parsee, Mr. Maneck K. Thanewala, of Rutlem, Central India. He says:

To describe the ceremony relating to the death of a Parsee: "When the case is seen to be hopeless, the body of the dying man is washed and dressed in clean but old white clothes. The 'Dustoor,' or 'Mobed,' with other priests, repeat sundry texts of the 'Zend Avesta,' the substance of which tends to afford consolation to the dying man, and he breathes a prayer on his behalf for the forgiveness of his sins: 'May the merciful Lord give you a good and happy abode in the world to which you are about to enter, and may He have mercy on you.' If the dying man be in the possession of his senses, he himself joins in these exercises; if not, his son, or nearest relative, or the family priest, bends over him, repeating the words in his ears. When life becomes extinct, the body is wrapped in clean clothes and placed on an oblong piece of polished stone, which is laid on the floor. The hands are laid crosswise and joined upon the chest, and the feet are crossed and tied or are kept straight. There is one point in connection with the ceremonies performed over a dead body about which people of other religious persuasions entertain most incorrect ideas. The face of the deceased Zoroastrian is exposed to the gaze of a dog three or four times during the recitation of the funeral sermon or oration. This seems to have led to the erroneous supposition that before the dead body is removed from the house, a dog is made to lick it or eat some portion of its flesh. It is scarcely necessary to say that this belief has no foundation whatever. This ceremony is called 'Sag did.' I may here mention that they ascribe to the glance of a dog the power of scaring away the evil being. With the same view, evidently, a dog is conducted over the way by which a deceased person has been carried, in order to make it again accessible for man and beast. The dog to be employed for 'Sagdid' must have certain special marks; he must be four-eyed, must have two black spots over his eyes, and must also be of a yellow color or white with yellow ears, so that the ceremony might be efficacious. This belief, however, is not generally shared in by the educated Parsees of the present day. The female members and relatives of the family then sit down together on a carpet spread in the room in which the body is placed, the men sitting on chairs or benches in the veranda. If death takes place at night, the body is kept in the house till the next morning; but if during the day—four or five hours before sunset—it is removed to its final resting place in the afternoon. Until the last funeral ceremony has been performed, a priest continues saying certain prayers before the corpse, burning sandalwood over a fire all the time.

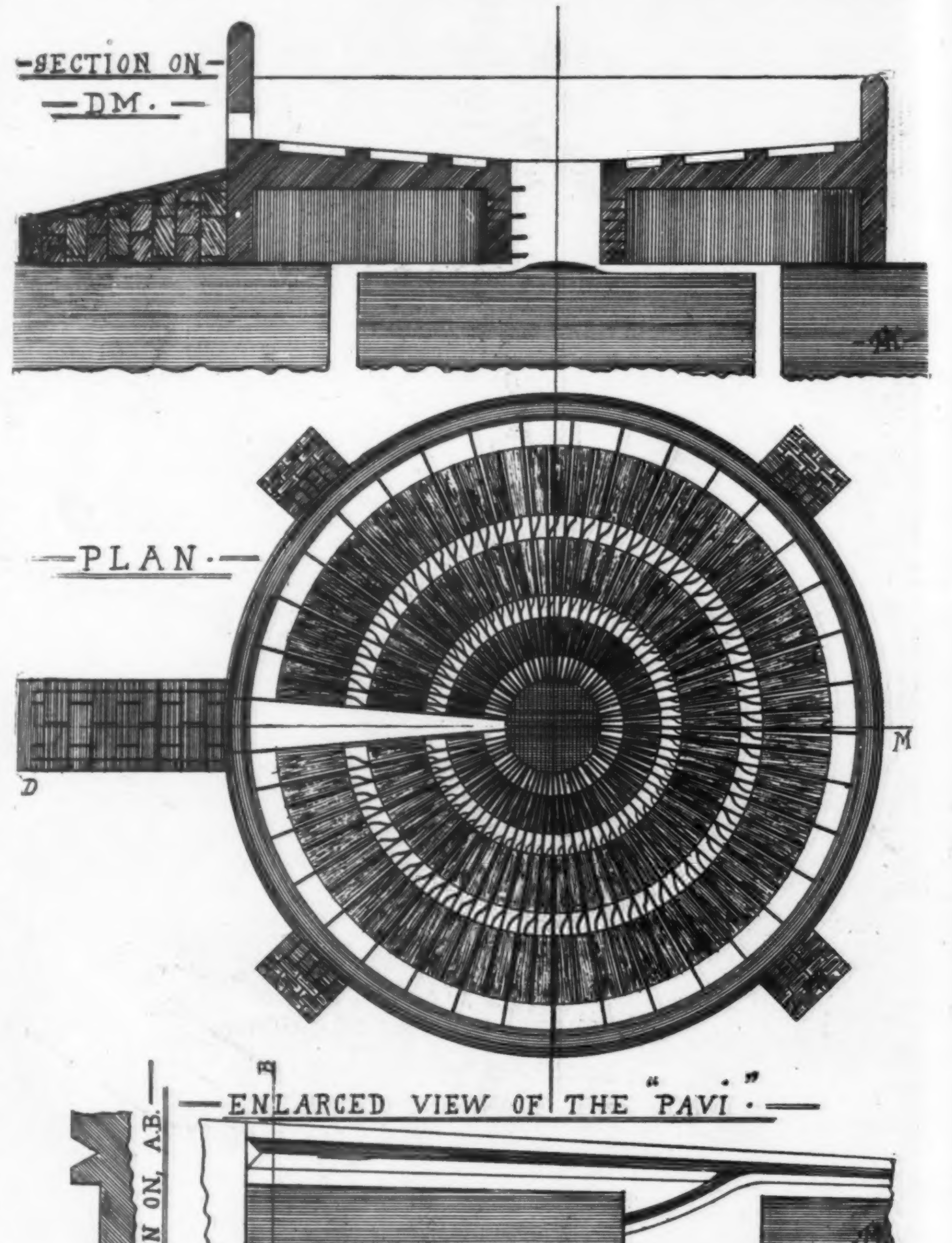
"When the time for the removal of the body approaches, it is placed upon an iron bier, which is brought in by the corpse bearers. Two priests then stand facing the corpse, but if a female bearing a child of more than five months is dead, two pairs of priests instead of one perform the ceremony, and recite the seven 'Has.' If the deceased be the husband of a surviving wife, his wife breaks the pair of glass anklets which she wears and throws them on to the corpse of her husband, and from that time she always puts on a black 'Sadi' without border, which is a mark of widowhood, ornaments not being resumed until a second marriage.

"When the recital is finished, the body is taken out of the house on the iron bier, and carried on the shoulders of four 'nasesalars,' or corpse bearers, to the 'Dokhma,' or the Tower of Silence, which is generally erected in a solitary place and upon an eminence. The relatives of the departed one naturally give way to cries and lamentations. The male relatives and friends of the deceased follow the dead body in funeral procession on foot. The carriers of the bier have their hands, feet and head bound in white cloth. Two sets generally accompany, so as to permit a change at intervals on the road to the 'Dokhma,' or Tower of Silence. The followers of the funeral procession proceed in couples, holding a handkerchief between them, and are in full dress, that is to say, the jama is worn. After the dead body is removed from the house, cow's urine is thrown as a disinfectant on the spot where it had lain, as well as on the path by which the corpse was taken out.

"Arriving at its resting place, the iron bier is put upon the ground, and the face of the deceased uncovered for a few minutes, in order that a last look may be taken of it, and the whole assembly bow before it. Here the dog is again brought in and made to gaze at the corpse. After a few minutes the body is taken by the bearers inside the 'Dokhma,' and the vultures, which are always in the immediate vicinity, soon denude it of flesh.

"The so-called Towers of Silence, which serve the Parsees in Bombay as places for the disposal of their dead, crown the summit of the magnificent Malabar Hill, which rises above the city. The view which they present is naturally most gloomy. A body of lazy vultures, densely crowded, guard the edge of the tower. There they sit, immovable and motionless, save when a funeral procession approaches, and the flock are filled with excitement. They fly upward with screams, and as soon as the dead body is laid within the tower by the bearers, they throw themselves with greedy haste upon their prey. In a few minutes the dreadful work is finished, and the heaven-sent birds return satiated to their place to wait for fresh food.

"When the corpse bearers take the body in the 'Dokhma,' they tear the clothes from the deceased and expose him or her to be devoured by the vultures. The clothes are taken out of the tower by the corpse bearers and deposited in a separate compartment set aside for them in the tower compound. Here the bearers take a bath and return home. The priests, relatives and friends who have attended the funeral wash their faces and hands and offer a prayer to the Almighty; and it is at this time that they loosen the handkerchief which they kept between each pair. After this every one goes to his own place. This is for those who follow the procession; but those who do not follow, sit in the house of the deceased for about



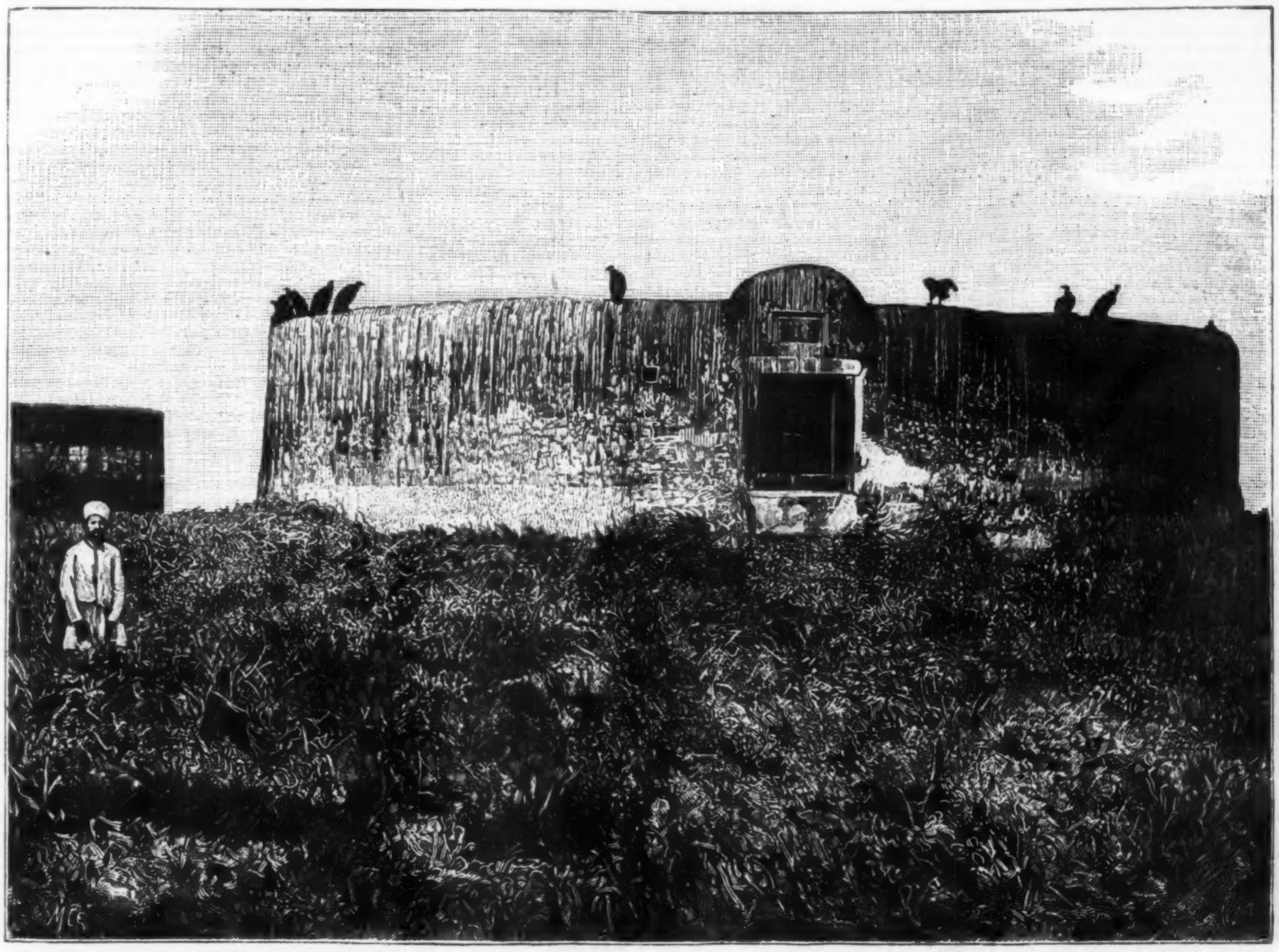
THE PARSEE "DOKHMA," OR TOWER OF SILENCE.

fifteen or twenty minutes after the corpse has been carried away from the house, and then they, too, retire to their own places.

"On the death of any person, his friends, neighbors and acquaintances visit the relatives of the deceased every morning and evening for three days consecutively to offer consolation to them, and sit in long array for a few minutes on benches and chairs placed along the side of the house.

"Originally the 'Dokhmas' were certainly nothing more than natural hills or primitive elevations of sand, earth or stones. In course of time the structure became a more elaborate one. The 'Dokhmas' must be erected on places situated on high, on the tops of hills or slopes. It is a rule that they must be uncovered and exposed to the solar rays and rain. The best idea that I can give of its outward appearance is to refer to the large circular gasometers attached to gasworks, the only difference being that the 'Dokhmas' are open at the top, while their circular walls are built of the hardest stone, faced with white 'Chunam' or lime plaster. The walls are from 20 to 30 feet in height, and the diameter of the largest 'Dokhma' in Bombay is 90 feet. Inside the tower is a circular platform entirely paved with large stone slabs, and divided into three rows of exposed receptacles called 'Pavis' for the bodies of the dead. As there are the same number of 'Pavis' in each concentric row, they diminish in size from the outer to the inner ring, and that by the side of the wall is used for the bodies of the males, the next for those of females, and the third for those of children. These receptacles or 'Pavis' are separated from each other by ridges called 'Dandas,' which are about an inch in height above the level of the 'Pavis,' and channels are cut into the 'Pavis' for the purpose of conveying all the liquid matter flowing from the corpses and rainwater into a 'Bhandar' or a deep hollow in the form of a pit, the bottom of which is paved with stone slabs. This pit forms the center of the tower. When the corpse has been completely stripped of its flesh by the vultures, which is generally accomplished within an hour at the outside, and when the bones of the denuded skeleton are perfectly dried up by the powerful heat of the tropical sun, and other atmospheric influences, they are thrown into this pit, where they crumble into dust—the rich and the poor, the young and the old—thus meeting together after death in one common level of equality. Four drains are connected leading from the body of the pit. They commence from the surrounding wall of the 'Bhandar' and pass beyond the outside of the tower into four wells sunk in the ground at equal distances. At the mouth of each drain, charcoal and sandstone are placed for purifying the fluid before it enters the ground, thus observing one of the tenets of the Zoroastrian religion, that 'the mother earth shall not be defiled.' The wells have a permeable bottom, which is covered with sand to a height of five or seven feet. These 'Dokhmas' or Towers of Silence are built upon one plan, as shown in the illustration, but their size varies. Some of the leading dimensions of the 'Dokhmas' shown are as follows:

	Feet.
Interior diameter of the tower, as limited by the parapet	62
The outmost diameter	70
The outer diameter at the plinth at the surface of the ground	66·8



THE TOWER OF SILENCE AT BOMBAY.

"The frustum or plinth has a batter of one foot in eight feet."

The dead bodies disappear in an incredibly short space of time, and often the birds fly away with pieces of the corpses in their bills which they drop into the gardens. It is little wonder that it has long been desired that the Parsees should erect a Tower of Silence some distance from Bombay, but the ceremonies of the dead before being placed in the Dokhmas require to be all performed within a certain limited time, and this could not be done if the bodies had to be removed far away.

For our front page engraving of the Parsee funeral we are indebted to the Illustrated London News. We are indebted for the exterior view of the Tower of Silence to L'Illustrazione Italiana.

NATURE STUDY AND INTELLECTUAL CULTURE.*

By JOHN M. COULTER, in Science.

IT is impossible to dissociate the intellectual effect of "nature study" from the other factors in training which habitually accompany it. So far as I know, no "pure culture" to determine the specific effect of nature study has ever been attempted; so that the best that can be done is in the way of reasonable inference. There can be no doubt that much of its effect is cumulative rather than specific, and so becomes merged and lost among other agencies. In addition to this general result, however, it is claimed that it has an effect of its own, not to be duplicated by any other subject. It is this specific effect of nature study that we are especially interested in discovering.

The argument for nature study as a means of general training is based upon the claim that the subject matter appeals more strongly to the interest of the young than almost any other that can be presented. The enormous momentum gained by interest is too well known to need discussion. That objects in nature, especially living objects, arouse the most lively interest in children is the common testimony of all those who deal with children. It seems logical to take advantage of this interest in any intellectual training, and to present the subject matter in all its possible applications, thus reinforcing or even supplanting work technically belonging to other departments.

The possible applications of nature study to numbers, to language, to drawing, are well known and extensively utilized. These propositions fail if interest in subject matter is of no advantage in intellectual training, or if natural objects are not of large interest to children. My claim is that nature is not merely of large interest, but of supreme interest to children; that it supplies the most natural material by means of which the child may be developed intellectually in various directions; and that failure to use it is to neglect a broad highway and to attempt an advance through the thickets. I know that some will claim that power is developed by the resistance of the thickets; but it should be remembered that precisely the same power will be developed by covering a longer distance upon the highway, especially when the latter has the impetus of consent.

The law of the conservation of energy has its application in things intellectual as well as in things physical. The greater the resistance, the less the distance, and vice versa. The method all depends upon whether we are seeking for resistance or distance; in both cases the resulting power will remain the same. I have never ceased to wonder at the systems of education which base their training, in effect, upon the proposition that the most natural impulses are to be repressed: that natural tastes are to be set aside for those artificially stimulated; that the great open book of objective nature is to be closed, and conventional subjective matter presented. From my own standpoint, this is intellectual distortion, as much as are the heads of Flathead Indians or the feet of Chinese women physical distortions. The subject is difficult to present in its true light, for we are still under the domination of a conventional education, which has worked out its results for centuries, and its good results are overwhelmingly in evidence because they are our only results.

Now that the republican idea of larger rights for all subjects is persistently intruding itself, the old aristocracy needs most careful scrutiny. It has certainly done the best it could; but this is no reason why some other form of organization may not do better. The human mind develops in spite of subjects and teachers; but our purpose should be to remove all possible obstructions.

It has been an annual experience of mine for many years to come in contact with the product of primary and secondary schools from which nature study has been rigidly excluded, and it must be confessed that the "all round" training claimed has resulted in the narrowest conceivable intellectual product. The evils of early specialization are nowhere so apparent as in the schools which prepare for college. It is true that many colleges demand this specialization for entrance, continue it in their own courses, and then deny an adequate representation of nature study upon the ground that this means specialization. The tentacles of inquiry which the child naturally reaches out to nature become insensitive through disuse; and only here and there, in the later college experience, are some found still functional enough to be stimulated into activity. The public school system is seeking to better the product; but it is discouraging so long as colleges demand specialization rather than an "all round" training.

It may be worth while to call attention to the fact that "nature study" holds no relation to the study of the subject matter as presented in textbooks, and that such a presentation of it has no value in a scheme of education that does not belong to any other subject presented in the same way, and for purposes of training might as well be eliminated. The young mind does not reach out after the textbook, but after natural objects themselves.

This distinction should be rigidly regarded, and textbook work should never be admitted into the category of "nature study." I grant to the old aristocracy all the strictures upon the results of science study it may care to impose if this study is to be one of textbooks. One of the prominent things claimed for nature study is that it breaks the shackles of slavery to the book and introduces that intellectual freedom in which one sees and thinks for himself.

This position of nature study, however, as a means of general culture, as providing the most favorable subject matter for arousing interest, is aside from the chief purpose of this paper, which is to discover its peculiar intellectual result, a result which cannot be obtained

* Prepared for presentation before the department of Natural Science Teaching, N. E. A., Buffalo, 1896.

by the use of any other subject, and without which intellectual development is incomplete.

It is commonly stated that the prominent results of nature study are the cultivation of the power of observation and of drawing conclusions from observed facts. This is certainly a beneficent result, but it cannot be claimed as one peculiar to nature study; for it simply depends upon a method, the laboratory method, which may be applied to a wide range of subjects. It is certain that nature study has introduced the laboratory method into education, but having introduced the method, it cannot lay claim, as a subject, to all the results.

It is, perhaps, true that the laboratory method is most conveniently and completely applied in nature study; and that in most cases the definite training in observation and deduction is still obtained from nature study; but this will become less true as proper educational methods are developed. For this reason I take issue with a statement too frequently made by those who have had no training in science, that the function of science in an educational scheme is to teach laboratory methods. It is true that science, by its example, has been the great teacher of the laboratory method, but that is not its function any more than the device of algebraic symbols is the function of mathematics. A method is not a purpose, but has a purpose in view.

Another conception of the function of nature study is that it cultivates the power and habit of analysis, and that its purpose is analysis. This is a persistent conception of science in the popular mind, and also in the minds of many teachers of science, judging by their methods. This, however, is no more the purpose of nature study than is the laboratory method. The latter is its method, the former its preliminary step. This preliminary step, called analysis, is no more peculiar to nature study than are observation and deduction; although it may be more extensively and definitely cultivated in the so-called laboratories of science than in other laboratories.

The ultimate purpose of nature study, and its peculiar function in a system of education, is through analysis to reach synthesis. Its purpose is a constructive one, based upon facts which analysis reveals. It may seem strange to some to regard the purpose of science as a synthetic one; and the final synthesis, which gives significance to analysis, certainly does not find any place in the practice of many teachers, but without it the real purpose is missed. It may be claimed justly that the reaching of synthesis through analysis is no more peculiar to nature study than are observation, deduction and analysis; but the mental attitude involved in reaching this synthesis is peculiar. This peculiar mental attitude may be most clearly stated, perhaps, in the form of a comparison. A very commonly used classification of studies in general is that which divides them into the "humanities" and the "sciences."

It lies outside of my present purpose to take exception to this exceedingly crude and misleading classification, but for the sake of comparison it will serve as well as any other. The "humanities" are dominated by literature in the broadest sense, and are claimed to develop in the student a kind of culture especially desirable, a flavor especially characteristic of the educated man. To this claim I would not offer the slightest objection, for the "humanities" have been and must continue to be a noble course of intellectual development, without which an education is certainly incomplete. I realize the difficulty to-day in sharply defining those studies which should be included under the "humanities," and a difficulty equally great in defining those to be included under "sciences," for it is often a thing of method rather than of subject matter which determines the position of a study. However, there is no misunderstanding as to the general significance and effect of the group of studies known as the "humanities." It is the most ancient and best known form of culture, and being ancient and bound up with the development of mankind, it must continue necessarily to hold high rank.

The general effect of the humanities in a scheme of education may be summed up in the single word appreciation. They seek so to relate the student to what has been said or done by mankind that his critical sense may be developed, and that he may recognize what is best in human thought and action. To recognize what is best involves a standard of comparison. In most cases this standard is derived and conventional; in the rare cases it is original and individual. In any case, the student injects himself into the subject; and the amount he gets out of it is measured by the amount of himself he puts into it. It is the artistic, the æsthetic, which predominates, not the absolute. It is all comparative rather than actual. The ability to "read between the lines" is certainly the injection of self into subject matter. It would seem fair, therefore, to state the peculiar effect of the "humanities" as being the power of appreciation or self-injection.

My claim is that any education which stops with this result is an incomplete one, and that there is another mental attitude which is a necessary complement before a full rounded education can be claimed, and this complementary mental attitude is developed by a proper study of the so-called "sciences." It has been a matter of wonder to me that the student who confines himself to "humanities" is so often spoken of as the "all round" student; while the one who studies the "sciences," and from whom the "humanities" are as a matter of course demanded, is spoken of as the narrow student. In the very nature of things, in the very structure of our educational schemes, the student of science is compelled to be the broadest, most "all round" student we have. If the study of nature is conducted so as to cultivate merely a sentimental appreciation of natural objects, it does not fall within the category I am considering, and can in no way be considered a study which acts as a complement to the humanities. It is merely more of the same thing. Teachers of science are too apt to cultivate a factitious interest in their subject matter by this attempt at self-injection, and so destroy the peculiar advantage of the subject in intellectual training. If the proper intellectual result of the humanities is appreciation, whose processes demand self-injection, the proper and distinctive intellectual result of the sciences is law, to obtain which there must be rigid self-elimination. Any injection of self into a scientific synthesis vitiates the result. The standard is not a variable, an artificial one developed from the varying tastes of man, but absolute, founded upon eternal truth.

It is evident that this basis of distinction will result in a classification of subjects differing considerably from the ordinary grouping under "humanities" and "sciences," but I am convinced that from the standpoint of mental development it is fundamental. It would even result in the divorcing of certain subjects now commonly included under one head. For example, it would certainly sharply cut off certain phases of language study from literature proper, a fact which the universities have long recognized. This further emphasizes the fact that no hard and fast lines can be drawn separating the specific effects of the various studies. In our analysis we strip off the flesh and lay bare the skeleton, and are apt to lose sight of the fact that the contour is a composite result. Although the skeletons of the humanities and of the sciences may differ from each other in the fundamental way described, I cannot conceive of the resulting contour of the one as distinct from combination with the other. The self-eliminating result of science must be associated with the self-injecting result of the humanities, even though science alone be studied; and the power of appreciation developed by the humanities must always be tempered by the scientific instinct. And yet the two processes and the two results are so distinct and so complementary that any system of education which does not provide for the definite cultivation of these two mental attitudes, and which leaves the complementary part merely to the chances of teaching methods and mental structure, is in constant danger of resulting in mental distortion.

WOMAN MEASURED BY MAN.

A comparison of the muscular strength of woman with that of man, including every important group of muscles from toe to crown, has been made by means of an improved dynamometer. The work was done by Dr. J. H. Kellogg, of Battle Creek, Mich., says the New York Sun, and the results were presented in a paper read by him at the tenth annual meeting of the American Association for the Advancement of Physical Education. Some of the most interesting parts of Dr. Kellogg's paper are reproduced here from the printed report of the meeting. He says:

"A most interesting line of research which the dynamometer has enabled me to undertake is a comparative study of the muscular system in men and women. The studies of this subject heretofore made have been chiefly based upon the results obtained by the use of the tape line. A few studies have been made by Quetelet and others, based upon such incomplete tests as the strength of the grasp of the hand, the weight which can be dragged over a level surface, etc., but the facts presented have been so fragmentary as to be of little value.

"In my personal studies by the aid of the dynamometer the principal comparisons which have been made are as follows, the figures given being based upon the study of 200 healthy young men between the ages of 18 and 30 years and an equal number of healthy women of the same ages."

Dr. Kellogg presents a table showing the relative strength of the various groups of muscles in man and in woman. "The figures which indicate the strength of each individual group of muscles for the average man and the average woman," he says, "are arranged in the order of their relative strength:

Men.		Women.	
Muscles of inspiration (pneumatometer)	0·9	Muscles of inspiration (pneumatometer)	0·4
Muscles of expiration (pneumatometer)	2·6	Muscles of expiration (pneumatometer)	1·4
Neck anterior	35	Neck anterior	19
Hand extensors	54	Hand extensors	29
Neck posteriors	75	Neck posterior	37
Arm flexors	120	Arm flexors	48
Neck lateral	123	Arm extensors	53
Arm extensors	127	Forearm supinators	57
Forearm pronators	134	Forearm pronators	57
Trunk anterior	139	Neck lateral	60
Deltoid	140	Deltoid	71
Forearm supinators	143	Trunk anterior	73
Foot flexors	145	Inspiration (waist)	79
Shoulder retractors	160	Inspiration (chest)	85
Inspiration (waist)	172	Foot flexors	89
Latissimus dorsi	185	Shoulder retractors	95
Inspiration (chest)	190	Latissimus dorsi	99
Leg flexors	210	Pectoral	102
Thigh abductors	216	Leg flexors	116
Pectoral	219	Leg extensors	123
Thigh adductors	227	Hand flexors	125
Leg extensors	237	Thigh abductors	135
Hand flexors	240	Thigh adductors	142
Trunk lateral	287	Trunk lateral	154
Thigh flexors	313	Chest	166
Thigh extensors	330	Trunk posterior	173
Chest	365	Thigh extensors	174
Trunk posterior	380	Thigh flexors	179
Foot extensors	614	Left arm	363
Left arm	751	Foot extensors	364
Right arm	770	Right arm	373
Trunk	1,042	Trunk	516
Right leg	1,131	Left leg	659
Left leg	1,131	Right leg	663
Chest and trunk	1,407	Chest and trunk	682
Both arms	1,521	Both arms	736
Both legs	2,262	Both legs	1,322
Entire body	5,190	Entire body	2,740

"It will be seen that the order in the two columns is not the same. Interesting differences and facts, a few only of which will be mentioned here, occur at many points:

"1. One of the most curious facts to be noted is that the foot extensors or calf muscles, in the average woman, have a strength almost exactly equal to that of the left arm.

"2. The anterior muscles of the neck, in both men and women, have about half the strength of the posterior.

"3. The hand flexors in men have just twice the strength of the arm flexors; in women, the hand flexors are nearly three times as strong as the arm flexors.

"4. In man the forearm supinators are considerably stronger than the pronators, whereas in woman they are of equal strength, although much weaker than in man, who is two and a half times as strong as the average woman.

"5. In man the latissimus dorsi and the muscles which move the upper chest in inspiration are equal in strength; in woman a similar parallel exists between the latissimus dorsi, the pectorals and the shoulder retractors.

"6. The inspiratory powers of the waist and chest are practically equal in woman, while in man the inspiratory power of the chest is perceptibly greater than that of the waist, although in each case the respiratory strength in man is double or more than double that of woman. This fact demonstrates the fallacy of the idea that restriction of the waist is a means of giving woman a superiority in upper chest development, and so acting as a preventive of pulmonary disease. Men, without waist constriction, have greater relative strength in the upper chest than have women.

"7. The total strength of inspiration (chest) is in women just one-eighth that of the total for the chest and trunk.

"8. The waist expanding capacity is almost exactly one-half that of the total for the two sides of the trunk in woman.

"9. The strength of the arm extensors in men is almost exactly one-twelfth that of the entire arm.

"Many other interesting comparisons might be made, especially those which relate to the strength of each group of muscles as compared with the whole body.

"The reasons for the unusual weakness of certain groups of muscles in women are, in some instances at least, quite apparent. The weakness of the arm muscles, for instance, is explained by the fact that women engage less than do men in laborious employments. The legs are relatively stronger than the arms in women, for the reason that the amount of exertion by the legs is more nearly equal in the two sexes than in the case of the arms. The greater strength of the thigh flexors is, perhaps, due to the fact that the bones of the legs are in women shorter than in men, so that the muscles acting upon the thigh have a better leverage than in men. The same reason will hold good for the thigh abductors and adductors, which are relatively the strongest muscles possessed by the average woman. The greater width of hips, perhaps, affords another anatomical advantage to the muscles of the thigh in women. These observations are entirely in harmony with the interesting fact pointed out by Quetelet and Sargent, that the thigh is not only proportionately, but actually larger in women than in men. The thigh is found to be relatively larger even in girls of twelve; and in girls of fifteen it is two inches larger than in boys of the same age. It is interesting to observe that the results obtained by the dynamometer entirely coincide in this particular with those noted by anthropometry. Heretofore there has been no means of knowing whether the larger thighs of women were the result of a greater proportionate development of the muscles or simply a greater accumulation of adipose tissue. It is probable that both peculiarities in structure are present, but the dynamometer has clearly shown that the thighs in women are not only larger but proportionately stronger, as compared with other muscles, than in men. As compared with men, the abductors are stronger in women of equal height than in the average man, the relation being 72 per cent. for the former to 65 per cent. for the latter.

"The muscles which are relatively weakest in women are the forearm pronators and supinators and the arm flexors. A very marked superiority in favor of men is also noticeable in the muscles concerned in respiration.

"The inspiratory strength of the waist and that of the chest, both as measured with the dynamometer and with the manometer, or pneumatometer, is relatively much weaker in women than in men, the disparity being: For waist inspiration, 1·18; chest inspiration, 1·24, and inspiration as measured by the pneumatometer, 1·25; or, respectively, 2¼, 2¼ and 2¼ times greater strength for corresponding parts concerned in inspiration in man than in woman.

"It is worthy of note that the disparity in expiratory strength, on the other hand, as measured by the manometer, is not so great, being only 86 per cent., or 1⅞ times as great in man as in woman, the latter being unity. The explanation of this weakness of the inspiratory power in women is clearly to be found in the impediment to inspiration afforded by the conventional mode of dress among civilized nations, and the resulting deterioration in muscular structures. It is quite safe to predict that such a deficiency would not be found to exist in the case of savage women.

"The obstacle existing in regard to inspiration does not exist in relation to expiration, since the constriction of the clothing would assist, rather than interfere with, expiration. If it be argued that the hindrance to inspiration is increased by tight clothing and ought to act as a sort of gymnastics of the respiratory muscles, whereby they would acquire greater strength, it is only necessary to say in reply that one of the best established principles in relation to muscular development is the fact that long continued and unrelenting opposition to muscular movement finally results in the tiring out and disabling of a muscle, rather than in its superior development. This is clearly seen in various forms of spinal curvature, as well as in other acquired deformities. Another prominent point of weakness in women is found in the muscles of the back, which are in the average man 2¼ times stronger than in the average woman. The pectoral muscles are also noticeably weak in women, which quite agrees with the weak inspiratory power of the chest previously referred to.

"Without going into all the relations of strength to height and weight which we have traced out, attention is called to the following as of special interest:

"1. The strength of the average woman, in comparison with her weight, is less than two-thirds that of the average man, as compared with his weight.

"2. The strength of the average woman, in comparison with her height, is only four-sevenths that of the average man.

"3. The total strength of the average woman as compared with the total strength of the average man is 0·53. The weight of the average woman as compared with that of the average man is 0·86. The height of the average woman as compared with that of the average man is 0·92. It thus appears that the average woman, while less than the average man in height, is still more inferior in weight, and presents a still higher degree of inferiority in strength. A comparative study of men and women between 40 and 50 years of age would possibly show women to be somewhat less inferior in weight.

"The full significance of these facts is recognized only when they are considered in connection with the law that weight increases with the cube of the height, whereas muscular strength increases only in the proportion of the square of the height. This principle gives the shorter individual an advantage over the

taller, so that while, according to this law, we might expect to find women weaker than men, they should not be weaker than men in proportion to their height. To make this point clearer, let us take an example: The average strength of twelve men, each 70 inches in height, was found to be 5,483 pounds. The average strength of fourteen men, each 65 inches in height, was found to be 4,653 pounds. The calculated strength of the men, compared with that of the average man, is found to be exactly 5,425 pounds—only fifty-eight pounds less than the actual strength observed.

"Applying the same rule in a comparison of men and women, the following result was obtained: The average strength of twenty-five men having an average height of 69 inches was found to be 4,810 pounds; the average strength of thirty-four women, 64 inches in height, was found to be 2,652 pounds. The calculated strength of a woman 64 inches in height, obtained by the same rule, and taking the average strength of twenty-five men 69 inches in height as a basis, is 4,130 pounds. By this we see that, applying the ratio of the square of the height as a means of determining the strength for a person of given height, women fall short of the strength they should possess, the deficiency in the above case being 1,478 pounds. In other words, the strength of woman is only 64 per cent. of what it should be as compared with man. An actual comparison of men and women of the same height brought out the deficiency still more clearly. The average strength of nineteen healthy women between the ages of 18 and 30 years, 65 inches in height, was found to be 2,660 pounds; the average strength of fourteen healthy men of the same age and the same height was found to be 4,653 pounds.

"We find in these observations an interesting confirmation of the correctness of the principle that the strength of two persons of different heights will be in direct ratio to the squares of their heights. It also appears that the actual facts, as observed by the comparison of the average strength of a large number of men and women of equal heights, agree very closely with those shown by calculation, since the nineteen women with an average strength of 2,660 pounds should have had an average strength equal to that of the fourteen men, whereas they fell short 1,993 pounds, or 43 per cent. According to this the strength of the average woman is 57 per cent. that of the average man of the same height.

"4. The strongest single group of muscles in the body in relation to body weight is the foot extensor group, which in men lifts 4·4 times the weight of the body and in women 3·1 times the weight of the body.

"5. The following groups of muscles in the average man, the muscles of both sides being included, are capable of lifting the entire weight of the body or more: Hand flexors, forearm supinators, deltoid, latissimus dorsi, pectoral, shoulder retractors, foot flexors, foot extensors, leg flexors, leg extensors, thigh flexors, thigh extensors, thigh abductors, thigh adductors, trunk anterior, trunk posterior, trunk lateral, inspiration (waist), inspiration (chest).

"6. In women the hand flexors, foot extensors, leg extensors, thigh flexors, thigh extensors, thigh abductors, thigh adductors, trunk posterior, and trunk lateral are each able to sustain the body's weight.

"7. Those muscles which are able to lift a weight equal to that of the body in men but not in women are: Forearm supinators, deltoid, latissimus dorsi, pectorals, shoulder retractors, foot flexors, leg flexors, trunk anterior, inspiration (waist), inspiration (chest).

"8. It is interesting to note that the strength of each division of the body is more than sufficient to lift the entire body. Even the smallest total found—that for the chest in woman—is able to lift 1¼ times the weight of the body. The highest total for a division of the body—that for the legs—indicates, in men, a strength sixteen times that required to lift the body weight. The arms in men are able to lift eleven times the weight of the body, while the muscles of the chest and trunk combined are capable of lifting ten times the body weight.

"9. The foot extensors are, in men, a little less than 50 per cent. stronger than in women, when compared with the body weight, although the flexors are but a little more than one-third stronger in men than in women.

"10. The strength of the inspiratory muscles as compared with the body weight in men is nearly twice that of women.

"11. The lateral muscles of the neck have a strength, in relation to the weight of the body, nearly double that of the same muscles in women, a fact which is readily explained by the greater size of the head in men.

"12. The back muscles are stronger in men in proportion to total strength, doubtless in consequence of the heavier arms, shoulders and head which they are required to sustain."

In concluding his paper, Dr. Kellogg says: "The results which have been presented in this paper, it is hoped, will constitute the beginning of a line of study which will prove both interesting and profitable. I do not present these results as being in any sense exhaustive, although they have occupied many months of painstaking work on the part of myself and expert accountants whom I have employed in making the necessary computations. If they shall serve to stimulate further inquiry in the same line, and if they are accounted worthy of recognition by this body of experts, I shall feel amply repaid for my labor. Indeed, I may justly say that I feel already amply compensated by the assistance which I have derived from the information obtained in dealing with the various classes of physically infirm men and women who have come under my professional care. I sincerely hope that some enthusiast in anthropometry who has more leisure for the pursuit of this very fascinating study may take up this line of investigation and carry it still further. I feel sure that the subject may be properly regarded as a mine of unexplored wealth in the aid which it will afford to scientific physical training."

THE TEMPERATURE OF THE SUN.

WE gather from Cosmos the following interesting experiment by Prof. Ceraski, carried out at the Moscow Observatory. He had the use of a large mirror constructed by Messrs. Gettliffe & Simon, of Paris. This mirror was remarkable for the accuracy of its construction. It was silvered at the back, and had a focal length of about 39 in. The thickness of the glass was varied to correct for spherical aberration, and a high degree of concentration could be obtained with it. The professor tried the old method of measuring the temperature at the focus when the mirror was exposed to direct sunlight, and found it to be about 3,500 deg. C. This experiment only proves that the temperature of the sun is higher than this. The experimenter then tried a similar experiment, using an arc lamp in the place of the sun, and with conditions as alike as possible. The intensity of the luminous source was then known to be very nearly 3,500 deg., but the temperature at the focus was found to be only 100 deg. to 105 deg. C. The professor proceeds to argue that as the temperature of the source in this case was incomparably greater than that at the focus, so the temperature of the sun must be very much higher than 3,500 deg. C. He also thinks that similar experiments may enable a true estimate of the temperature of the sun to be obtained.

MILTONIA SPECTABILIS MORELIANA DULCOTE VAR.

IN addition to the type, there are now five or six recognized varieties of Miltonia spectabilis, all of them very beautiful orchids when kept free from thrip and otherwise well grown. The most beautiful variety, however, is M. spectabilis Moreliana, and here again, with so variable a species, it is little wonder that the variety shows considerable variability. Morel's variety differs from the type in having sepals and petals of a very deep rich purple color, and in its broad, flat labellum veined with rose. A form of M. s. Moreliana named atro-rubens has very large flowers, and the sepals and petals are of a very dark crimson purple hue. Another form, named rosea, has very pretty flowers, the sepals and petals being whitish, with a rosy central band; this blooms during the summer, whereas other forms of M. s. Moreliana bloom about September. The Dulcote variety of M. s. Moreliana, figured herewith, has flowers of immense size, quite surpassing the varietal type both in intensity of color and size of flower; it comes nearest to the form known as atro-rubens, but is scarcely so deeply colored, though it exceeds it in size, measuring fully four inches from the tip of the dorsal sepal to the front of the lip. When shown by Mr. Cobb, of Tunbridge Wells, in September, 1896, at a meeting of the R. H. S., an award of merit was made to the Dulcote variety.—The Gardeners' Magazine.

MILTONIA SPECTABILIS MORELIANA DULCOTE VAR.

THE ACTION OF GAS ON VEGETATION.

IN the course of a year gas companies over the country are called upon to put out what must amount in the aggregate to a considerable sum of money to appease citizens along the line of gas supply for the loss of shade trees, the cause for the decay of the foliage being attributed to the action of gas, says the Progressive Age. It may be politic for a gas company to allow itself to be bled in this manner, though in ninety-nine cases in every hundred gas is not properly chargeable with the destruction.

Mr. Lewis Collins, secretary of the Brooklyn Tree Planting and Fountain Society, in a recent communication to the citizens of that community, calls attention to the damages to life and limb from decaying trees, and in the course of his remarks says:

"It may be well to call attention to a few facts in relation to the life of trees. The vegetable kingdom is much like the animal, for the general law of nature, early maturity insures early decay, applies to both. A dog matures at the age of 2 years, a cow at 3, a horse at 4 and a man at 20. A dog is old at 8, a cow at 12, a horse at 16 and a man at 80. Early maturity rather than longevity has been considered in the selection of trees and the death of many of them is in conformity with this law of nature. Trees are like animals in another respect, for accident and mismanagement may shorten their lives. Horses have been allowed to gnaw the bark from many trees, and the injury has resulted fatally in many instances and will do so in the near future in many more. The guards that have been placed around trees have killed many and injured many more. The flagging has been placed too close to trees and many have suffered on that account. Kerosene and various mixtures that have been placed upon the trunks of trees to prevent caterpillars from going up have killed more trees than caterpillars have. Improper pruning has killed many. Some have perished from lack of nourishment, having been planted in subsoil having no fertility, the best soil having been removed in grading for streets. This may apply to both cuts and fills. Gas has killed some trees, but few compared with other agencies. It has been used somewhat as a scapegoat, receiving blame for loss of trees clearly due to other causes. If some care be taken to select long-lived trees for transplanting, and if they receive better care, the next generation will have less dead trees to remove. It is not intended to create unnecessary excitement in regard to dead trees, but rather to call attention to them, for their removal sooner or later will become imperative. There are some dangerous trees that are not dead. It will be well, when the owner is not able to decide, to ask the advice of some one who is competent to judge correctly to examine such trees and report upon their condition. The opinion of one who is seeking the job of their removal is not always unbiased."

It is certainly a matter of congratulation that a man so thoroughly acquainted with trees and their ailments as Mr. Collins assuredly is should be so outspoken in his reference to the subject.

So long ago as 1870 a litigation which grew into considerable magnitude before it was settled arose at Aix-la-Chapelle, in France. The city authorities brought suit against the gas company for recovery of supposed damage to the shade trees of that city resulting from alleged careless pipe laying and subsequent leakage due thereto. As the suit progressed eminent chemists were brought to testify after prolonged investigation of the question. The tests were made with pure hydrogen, light carbureted hydrogen and heavy carbureted hydrogen, as well as purified illuminating gas. A discharge during an entire day of these various gaseous substances into the soil of vessels containing growing plants was found to produce little, if any, hurtful result. We, however, incline to the belief that improperly purified illuminating gas, gases containing a large amount of tarry matter, mingled with carbonic acid, would have an unfavorable action on vegetation if allowed to percolate for any length of time among the roots of young trees or plants.

A German experimenter reported some years ago that in an experiment made by him, covering an entire year, ordinary purified illuminating gas was allowed to discharge for three hours daily at the roots of a well matured plant, and the effect was to produce rapid and fuller development.

BASIC SLAG AS A FERTILIZER.

By F. E. THOMPSON.

THE material commonly known as basic, Thomas, or phosphatic slag has been in the American fertilizer market for about eight years. It is obtained as a by-product in the manufacture of steel from phosphoritic pig iron. The slag contains from 15 to 23 per cent. of phosphoric acid and from 40 to 55 per cent. of lime and magnesia. These constitute the fertilizing ingredients, the residue of the slag being made up of silica and oxides of iron, manganese and aluminum, with small quantities of sulphide and carbonate of lime.

The consumption of this material in the United States has been very limited. The agricultural experiment stations have given some attention to the slag as a phosphatic fertilizer, but their very favorable reports have not brought about any greatly increased consumption. Probably the high price heretofore demanded for basic slag, under the patents which con-

trolled the sale in America, has been the most potent influence in restraining sales.—Ohio A. Exp. Station, Bull. No. 71, April, 1896, p. 168.

The slag, at the completion of the process whereby it is formed, is a molten, white hot, homogeneous mass, which is generally poured out so as to cool in a layer from 1 to 3 in. in thickness. When cold, the crude slag is readily broken up. The dried lumps are then ground to a fine powder in a pulverizing mill. In this dried and powdered condition the slag is ready for use as a fertilizer, without further treatment. It keeps unaltered for years, has no odor, and, being a poor absorbent of moisture, does not cake in bags or barrels. There seems to be nothing in the source or preparation of basic slag to warrant a high price being asked for it.

A good sample of slag should show, by chemical analysis, at least 19 per cent. of total phosphoric acid, and should be of such fineness that at least 75 per cent. of it will pass through a sieve of 150 meshes to the inch. This fineness of subdivision is essential. None of the phosphoric acid in basic slag is soluble, so that its availability varies with the fineness of the slag particles.

In common with the natural or raw phosphates, Thomas slag does not yield up all its phosphoric acid in one season. A reserve store of acid remains in the soil as a latent fertilizer, while the changes of weather between crops slowly disintegrate the slag, preparing new available phosphoric acid for succeeding crops. On the other hand, in contrast with the raw phosphates, finely ground basic slag, during the first year of application, yields up its phosphoric acid much more readily than do the phosphatic rocks, guano or ground bone. In this respect it more nearly resembles the soluble phosphates, on some crops equaling or even exceeding dissolved bone black in efficiency.

Some of the State agricultural experiment stations have made tests of basic slag as a fertilizer, and have from time to time published the results. These reports constitute our principal American testimony concerning the slag. Although shipments of slag from the factory seem to show that it is meeting with favor in certain localities, it is very difficult to obtain any reports of value from the consumers. In Europe, the extensive sales of the material, the experiment stations' reports, and the fairly copious literature on the subject, indicate that the use of Thomas slag as a fertilizer has passed the experimental stage and has become a settled fact. In this country the slag is still on trial.

The English and German literature on basic slag is not readily accessible to most American readers. The announced results from its use in Europe are condensed in a paper by Dr. William Frear, in the Agricultural Report of Pennsylvania for 1890, p. 98. Most of the experimental work on slag in the United States has been undertaken since the publication of Dr. Frear's paper, and has never been summarized. The American results confirm the conclusions reached in Europe, which were briefly as follows:

(1) The more finely ground slag showed a higher availability in both chemical and agricultural tests.

(2) Two pounds of slag phosphoric acid had, during the first year, an effect equal to one pound of soluble phosphoric acid.

(3) Thomas slag was most efficient on wet clay soils, least efficient on dry or sandy soils.

(4) The slag gave the best results when used with other fertilizers.

(5) The residual effect of slag phosphoric acid was about twice that of soluble phosphoric acid.

(6) No bad effects from the use of basic slag were ever noticed.

In many European tests the slag proved equal to soluble phosphates.

The experiment stations in this country have generally used basic slag in combination with potash and nitrogen against either an equal money value of some other phosphate or an equal contained weight of phosphoric acid. There follows a summary of the station tests on Thomas slag.

Experiments on Corn (Connecticut State Station Report, 1889, p. 203).—This was a series of one, two and three years' tests of slag and other phosphates on corn. Equal money values of the different phosphates were combined with the same form and quantities of nitrogen and potash. Phosphates were applied during the first year only.

In a three years' test of dissolved bone black, slag, Grand Cayman's phosphate and South Carolina rock, Grand Cayman's phosphate led in yield on the first year's crop, while slag led in yield on the second and third year crops. The residual effect of all insoluble phosphates was seen during the second year and was equally apparent during the third year. Dissolved bone black failed to produce any increase in yield during the third year.

In a two years' test on corn (ibid.), dissolved bone black was most effective in increasing the crop during the first year, but was nearly exhausted from the soil in one year. On the second year's crop Bolivian guano ranked first, slag and Grand Cayman's phosphate next, and Carolina rock last.

In a single year experiment on corn (ibid.), dissolved bone black again led in crop producing power, while basic slag outranked all insoluble phosphates.

Three other single year experiments in Connecticut were barren of results, unfertilized plots sometimes doing as well as plots receiving dissolved bone black.

Another trial on corn (ibid.) showed that dissolved bone black led among phosphatic fertilizers, Mona Island guano being next, with slag and Grand Cayman's phosphate third. South Carolina rock and Bolivian guano produced no gain.

In a six years' test (Hatch, Massachusetts Agricultural Experiment Station Report, 1896, p. 128) of dissolved bone black, Mona Island guano, South Carolina floats, basic slag and Florida phosphate on crops in rotation, the slag produced 15 per cent. more corn than the next most productive phosphate (floats) and 26 per cent. more corn than the least productive phosphate (dissolved bone black).

In a two years' experiment on corn and oats (ibid., p. 142), basic slag being compared with ground bone only, the slag produced during the first year 25 per cent. more corn than did the ground bone, and, during the second year, 20 per cent. more corn.

The general results of three separate single year trials of fertilizers on corn in five crop rotation (Ohio Bulletin, No. 71, p. 119) showed basic slag to be at least equal to bone black superphosphate, and equal to 8 tons of barn yard manure per acre, while slightly superior to acid phosphate.

In a test of fertilizers on corn grown eight years in succession (ibid., p. 143), linseed oil meal and acid phosphate produced the largest average increase over unfertilized plots, basic slag ranking next. The average increase in yield from basic slag was but a half bushel below the best average yield. The slag in this test proved to be 30 per cent. more effective than dissolved bone black.

Competitive trials (Rhode Island Experiment Station Report, 1893, p. 141) of dissolved South Carolina bone, dissolved bone black, double superphosphate, slag and floats on corn showed nearly equal results from all except floats.

The South Carolina Station (Report 1888, p. 151) finds basic slag as effective on corn as the more expensive fertilizers.

The Vermont Station (Report, 1888, p. 89) concludes that on heavy soils basic slag is equal to soluble phosphates for increasing the corn crop, while on light soils the slag is inferior. In box experiments on corn, basic slag proved as effective, dollar for dollar of cost, as the soluble phosphates.

Experiments on Oats.—In the two years' experiment previously referred to (Massachusetts Report, 1896, p. 142), in which slag and bone meal were used competitively on corn and oats, the slag produced each year 50 per cent. more oats than the bone meal.

In a three years' test on oats (Ohio Station Bulletin No. 3, 1892) with slag in competition with dissolved bone black, acid phosphate, manure and linseed oil meal, dissolved bone black produced the largest average increase over unfertilized plots, while slag ranked second in productiveness.

On oats in five crop rotation, following corn (Ohio Bulletin No. 71, p. 126), slag proved the least effective of any fertilizer except linseed oil meal. On oats seven years successively (ibid., p. 142), slag proved slightly inferior to acid phosphate, slightly superior to dissolved bone black and much superior to linseed oil meal or manure.

Comparative tests of slag and floats on oats at the South Carolina Station (Report, 1888, p. 151) showed the slag to be more effective.

Experiments on Wheat.—In five crop rotation (Ohio Bulletin, No. 71, p. 126) superphosphate, linseed oil meal and wheat bran were ahead of slag when applied to wheat. In three crop rotation (ibid., p. 136) superphosphate (dissolved bone black) produced the greatest gain in the wheat crop, followed by the slag, in competition with manure, wheat bran, linseed oil meal, bone meal and acid phosphate. On wheat in seven years' continuous culture, slag produced a smaller average increase of crop than bone black superphosphate, manure or linseed oil meal, but produced a larger average increase than acid phosphate.

Experiments on Potatoes.—The results on potatoes are at variance with one another. The Connecticut Station (Report, 1889, p. 217) found slag to be more effective than any other fertilizer. The Massachusetts Station (Report, 1896, p. 130) found that dissolved bone black and floats lead slag on potatoes. In Ohio (Bulletin No. 71, p. 133) slag compared very unfavorably on potatoes with every other manure. In Vermont (Report, 1888, p. 89) slag produced more potatoes than did floats, bone black meal or acid phosphate.

Experiments on Other Crops.—On cotton, the Georgia Station (Bulletin No. 2, 1889, p. 37) found slag to be superior to floats but inferior to acid phosphate. The South Carolina Station (Report, 1888, p. 151) found slag to be less effective on cotton than acid phosphate, reduced phosphate or floats.

On stubble cane in Louisiana (Bulletin No. 31, second series), Thomas slag was about equally productive with soluble phosphates, but was much superior to insoluble phosphates.

In the six years' trial of phosphates on crops in rotation at the Massachusetts Station (Report, 1896, p. 128) we find that slag was first on serradella and barley and second on rye.

We have had no conclusive results in America with slag on hay, clover, vegetables or small fruits. In Europe the slag proved very efficient on small fruits and vegetables and also on hay and clover when grown on moist meadows.

In reviewing the experiments on corn, it is seen that basic slag, in competition with numerous soluble and insoluble phosphates, ranked first in six experiments, ranked second in five cases and ranked third in three cases. No phosphate except dissolved bone black was more effective than slag on corn in more than a single instance. As a phosphoric fertilizer on corn, basic slag appears to rank easily with dissolved bone black and to be superior to all other phosphates.

From more meager data we find that on oats Thomas slag proved most effective in three cases and ranked second in two cases. In one case slag was inferior to all phosphates. Acid phosphate and dissolved bone black generally lead basic slag. In six trials the slag was equal or superior to soluble phosphates in five, inferior to all phosphates in one. It seems safe to say that basic slag ranks at least next to soluble phosphates on oats and that it is superior to other insoluble phosphates.

From the Ohio experiments using slag and other phosphates on wheat, we find that slag was always inferior to dissolved bone black, generally inferior to wheat bran and linseed oil meal and always superior to acid phosphate. Neither wheat bran nor linseed oil meal is a true phosphatic fertilizer.

The results of experiments on other crops have been too meager to admit of positive statements regarding the comparative fertilizing value of basic slag.

The Massachusetts Station, after a six years' trial of various phosphates on crops in rotation, has this to say about basic slag (Massachusetts Report, 1896, p. 131): "We find that the plot receiving dissolved bone black leads in yield during the first two years, while for the third, fourth, fifth and sixth years the plots receiving insoluble phosphates are ahead, phosphatic slag being first."

Probably the most valuable and complete series of American experiments using basic slag is that detailed in the Ohio Bulletin, No. 71, covering a period of eight years. In summarizing we find this (p. 185): "Of the various carriers of phosphoric acid, dissolved bone black, acid phosphate and basic slag seem to produce practically the results, pound for pound, of phosphoric acid contained."

Other conclusions, very favorable to basic slag as a phosphate, may be found in the Connecticut Station Report, 1889, p. 120; Georgia Bulletin, No. 2, January, 1889, p. 37; Massachusetts Station Report, 1896, p. 144; Ohio Bulletin, No. 71, p. 164; Louisiana Bulletin, No. 31, second series, p. 1110.

ORIGIN OF THE VERTEBRATES.*

By Stuart Jenkins.

The metamorphoses exhibited in the development of the frog may be taken as another indication of the compound nature of the vertebrate organism, the tadpole displaying in a modified form the characteristics of the matrix, and the mature animal the final adjustment between the associated organisms. The phenomena can scarcely be claimed as the result of natural selection, because in all essentials the tadpole is just as well fitted to live as the frog, and a further development was not necessitated by the struggle for survival. If it were, the tadpole state must be considered as one highly detrimental to the race of frogs, and so likely either to be eliminated or else bring about the destruction of the race. If the form of the mature frog was evolved by the operation of natural selection on spontaneous variation, the tadpole stage would have been left behind millions of years ago, because the law of survival provides for no dual existence. It leads up to a type which proves its fitness by surviving, but it does not add a supplementary development to this type so as to convert it in one generation into an entirely different one. And yet, if we do not believe this, how are we to account for the existence of the tadpole as an independent, self-supporting organism on any theory of gradual development? Again, if we accept this theory of gradual development, we must believe that at one time the tadpole was the adult animal and able to reproduce its kind, and there is no obvious reason why this power should be lost and transferred to a later stage.

These difficulties disappear in the light of parasitism. In the first individual of the type there existed the future intention of the perfect frog, which is the resultant of definite internal forces. The tadpole stage remains because the imperfect adjustment of the sexual functions, characteristic of fishes, has never been lost. The egg of a frog is in effect a fish egg, capable of producing a fish, or rather a modified form of the matrix, but no more, because it does not contain enough of the special nutrition provided by the parent to carry the development any further. The tadpole, consequently, has to hunt its own living at a much earlier stage in its development than is the case with the embryos of the higher vertebrates. In the case of the Surinam toad, the mother, by a very remarkable arrangement, supplies the nutrition necessary for the whole development, and the young leave her as fully formed toads; but this is an altogether extraordinary and exceptional modification of the normal process. The retardation of the sexual function in the tadpole is due to the development of the cerebro-spinal nerve parasite. This in the first instance made small demands upon its matrix, while in its subsequent development it made increasing calls upon the latter, and by so much retarded its arrival at maturity. Reproduction, with very few exceptions, is the last function to develop, and it is only reached when the necessities of rapid growth have been so far satisfied or the powers of assimilation have so increased that there is a surplus of nutrition over and above the immediate wants of the organism. The growing predominance of the parasite would cause an increasing retardation in the development of its matrix, and with it a retardation of the reproductive function. Where this function is developed during the larva stage it must be due to superior nutrition. In the so-called larva forms, which are, of course, sexually mature, the early development of the reproductive function has resulted in a permanent modification of the parasite.†

The evolution of an internal bony skeleton has always seemed to me to present special difficulties. The ganglionic type of animals has from the first traveled in one rut. The lime which is assimilated is passed through their tissues and excreted on the surface, and it is very difficult to conceive why certain cells in the organism should break through this confirmed habit of growth and begin to retain and excrete the lime internally, not in an irregular and haphazard way, but on fixed lines and in a well marked direction. I do not think that spontaneous variation will account for anything so palpably definite. But even granting that it will, we are met by another difficulty, one that seems insuperable. The spontaneous variation was, of course, cumulative, that is to say, it only assumed a definite character through long and gradual development. In the first instance it was confined to a few cells which became differentiated from the surrounding tissue, and put on a new habit of growth. They were in no way connected with the organs of generation, which would of course produce the normal cell growth of the organism. How is it conceivable that a few isolated cells could so influence the product of generation that the new habit of growth which they had put on would be reproduced in the offspring? This objection applies with even greater force to the evolution of the ganglionic nerve system, because this took place in a mass of homogeneous cells without any circulatory system, and where there were no reproductive organs belonging to the organism as a whole, but where each cell reproduced on its own account, some of the new cells being added to the parent tissue, and some being cast loose into the sea to start a new community. Now, if certain cells in the parent mass differentiated into a new kind of cell would constitute what pathologists call a morbid growth, and if they reproduced their kind, part of the offspring would be added to the parent tissue and part would be cast off, as in the case of the normal cells; but

* Continued from Supplement, No. 1104, page 17642.

† This explanation is borne out by the fact that when the hermit crab (Pagurus) is infested by a parasite belonging to the group of Rhizocephala, the development of sexual maturity is wholly arrested, while the growth of the Pagurus itself is not in the least hindered. The fact is also illustrated in another way by the worker bee, which is an aborted female, capable in the larval state of being fed up into a queen. I have not attempted to touch in this article the bearing of parasitism on entomology, but it must be obvious that it affords the simplest explanation of the phenomena of metamorphosis.

on only one supposition is it conceivable that the two kinds of cells would come together to form a new compound organism. If the nerve growth was parasitic, then its germs, in accordance with the law which governs all parasitic growth, would attach themselves to their appropriate matrices, because from them, and from them only, could they secure that particular form of nutrition which was necessary for their existence.

When we try to trace the bony framework of the vertebrate back to its source, we are struck by one significant fact—it is invariably associated with the cerebro-spinal nerve system. Indeed, with the exception of the point where the two systems, as it were, lap, we find that a ganglionic nerve system is accompanied either by the absence of calcification or, where this is present, by external limy covering; while with the advent of the spinal cord, the calcification is rapidly converted into an internal skeleton. Not only that, but the intricacy of this skeleton bears a direct relation to the development of the cerebro-spinal nerves. It is impossible in considering this very obvious connection to avoid the conclusion that the internal bony framework is the result of nerve development, and that the growth of both has been determined by a definite impulse. Even in the most rudimentary forms there is a foreshadowing of the complete vertebrate, and through the ascending types we see, as in the embryo, the action of numerous forces tending toward a fixed resultant. If we try to explain this by natural selection or utility working through millions of years, we are met by the contradiction that the rudimentary types have proved themselves as capable of survival as the most advanced, whereas many of the latter, for no very obvious reason, have become extinct. Before natural selection could produce a change of type, we must suppose that the spontaneous variations on which it acted must have conferred so great an advantage on the first few individuals possessing them that they were able ultimately to entirely supplant the less favored; in other words, the latter would die out. That must be their fate if they were reduced to a minority, because superiority could only tell in the presence of keen competition, and keen competition means death to the weak or defective, and unless they were so reduced, they would breed back the variations to the level of the herd again by sheer force of numbers. Now the fact that the rudimentary forms have survived shows that they cannot have been reduced to a position of hopeless minority, but that in spite of the supposed advantages accruing to their competitors from superiority of structure, they have been able to hold their own in the struggle for existence; so that it necessarily follows that whatever causes may have led to the evolution of a higher type from a lower, the maintenance of life was not the efficient factor. This throws us back once more on spontaneous variation—an unknown quantity. In face of the facts, I think that there is but one reasonable conclusion—that there has been an internal evolutive force working on definite lines; and I believe that parasitism offers an adequate explanation of the existence of such a force, and why in the case of the vertebrates, through an arrest of development in the first instance, it has exhibited an upward and ever progressive tendency along an approximately determinate course. This fact of predetermination, so forcibly impressed upon us, has been one of the thorns in the path of the evolutionist. We see it exemplified in the development of the embryo and attribute it to "heredity"—to the slow accumulation of infinitesimal impulses transmitted through countless generations. But in the case of the first vertebrate there were no such influences behind it, or what there were tended to drive it away from the vertebrate form back to the older type. Is it conceivable that chance variations acted upon by haphazard external influences were capable of tearing the organism away from these powerful tendencies and driving it along a fixed path? I do not see how we can believe it, especially when we consider the fact that the older types have proved themselves just as capable of survival as the new, and that they still maintain their own existence and propagate their kind with an equal if not greater facility. Even in the case of the embryo I think the operation of the force called "heredity," as well as its character, is entirely misunderstood. We know that the offspring is like the parent, and we try to explain the fact by a hypothetical force called heredity, which is made up of a mass of influences long since passed away, and not even acting on the parent except by transmission, accomplished I presume by some operation analogous to that of memory, only of course unconsciously and involuntarily. Now we know that there is a fixed limit to the acquiring power of the human mind, and that the number of items (words or otherwise) which can be retained in the memory is somewhere in the tens of thousands; yet in the case of heredity we have millions of impulses vibrating through illimitable eras, and impressing their accumulated stamp upon the offspring of the race. Not only that, but as the highest as well as the lowest organisms begin their life as a mass of protoplasmic cells, and these cells generally reach the type of the organism to which they belong before they are brought into contact with external influences, we must believe that the millions of impulses are stored up and vibrating in the microscopic germ, and waiting to exert their influences on the growing organism. So that a microscopic vesicle has a greater capacity for storing impressions than, let us say, the brain of a Cuvier. That is the logical conclusion, and there is no getting round it. The germ in a hen's egg is completely isolated and must therefore contain within itself the future intention of the perfect fowl. It is supposed to pursue approximately the path which led the primitive cell to the Pterodactyle, and the Pterodactyle to the Gallus Bankiva, and it must therefore remember and avoid all the undesirable side tracks leading off the trail, and follow only the path planned out for it by natural selection. When I say remember, I mean that the process is literally comparable with the operation of memory, which, in the case of so-called instinctive actions, leads to certain definite results through the impulse of accumulated impressions. That is actually what happens with the germ according to the ordinary view of heredity, only the operation is infinitely more complex; for while the mind only stores a certain proportion of the impressions of a lifetime, the germ contains the accumulated impressions of millions of years. Is such a hypothesis tenable or even conceivable? Writers on this subject show very clearly that science has not yet wholly emerged from beneath the shadow of supernaturalism. They still look for obscure and mysterious forces in the organic world, instead of recognizing that here as elsewhere the forces are mechanical.

If we take up the question from the standpoint of the doctrine of parasitism, we get an entirely different and vastly simpler explanation. The highest development of any type is the resultant of opposing forces contained within the organism, modified, and to a certain extent controlled, by the character of the nutrition which the organism absorbs and its power of elaborating it. The ultimate type of the organism has been determined by the action and reaction of these forces upon each other during a period which, in relation to the type, corresponds to the embryonic stage of the individual; and its ultimate form is the immediate result of the final development of its system of nutrition. Now we have in the embryo the same elements which by their interaction have contributed to the formation of the type, and we have supplied by the parent the special form of nutrition which has determined its ultimate form, and consequently there are present during the growth of the embryo, not a mass of obscure impulses, but the very factors which have evolved the race, actively working and moulding the development of the germ. And I do not know that we are not justified in believing that the successive developments, which now characterize the individual, were exhibited and completed in the first member of the type, but spread over a much greater length of time, owing to a temporary arrest of development in the parasite, a check which it has now no longer to contend with. The implantation of a parasite and the impregnation of an ovum are so exactly parallel in their operation and subsequent growth that it is not necessary to suppose the interposition of many individuals in order to bring about a perfecting of the type. Indeed, the phenomena of embryonic development rather favor the conclusion that the evolution of the type was an individual and not a racial matter.

The bearing of parasitism on neurology opens up a very wide field and one that will stand a great deal of working. I cannot attempt to enter into the subject here, but I may note one point that seems to be indicated, viz.: That all attempts to connect nerve influence with electrical action must prove futile. Indeed, such an explanation is no longer necessary. The attack of the parasite on its matrix sufficiently explains the phenomena of muscular contraction, while the transmission of sensation is as simply accounted for by the irritability of the living substance of the nerve animal. In fact, contractility and sensibility are phases of the same quality differently exhibited, and the reason why we do not feel the contraction as a sensation is that it takes place in a separate organism—the matrix—of whose individuality the ego or nerve animal is unconscious, except remotely through chance connections with the great sympathetic. The phenomena of sensibility are exhibited in the most elementary forms of animal life. "They are divided among as many cells as the individual contains, and they exist in a vague and diffuse manner, without there being as yet a special system of anatomical elements designed to serve them as an appropriate receptacle." (Luys.)

These phenomena are clearly not electrical, being simply a response to external stimuli; and I can see no good ground for separating them from the phenomena of nerve action because in the one case they are simple and in the other infinitely complex—the difference is one of degree, not of kind. The fact that contraction can be induced in fresh muscle either by mechanical irritation, strong acids or electrical stimulus, proves too much for the electrical theory, and the only safe deduction that can be drawn from it is that the cells of the tissue are still living and capable of shrinking from attack. Vital energy and electricity may or may not be allotropic forms of the same force, but so far no attempts to connect the two have reached the point of demonstration. As the transmission of both light and sound is due to mechanical impulse, it is not necessary to seek for any other explanation of the transmission of sensation. As a matter of fact, the whole five senses may be reduced to an exquisite development of the sense of touch.

I have thus endeavored to indicate the manner in which the theory of parasitism clears up some of the most obscure points in the evolution of the vertebrate organism, and indeed of all compound organisms. The possibility of the parasitism will, I think, hardly be questioned in view of the very curious facts already brought to light in regard to recognized parasites. Semper, in his work on "Animal Life," actually came within sight of this simple explanation of the compound organism, without, however, recognizing it. In discussing the subject of constant association, he says:

"We are now accustomed in all such cases of deviation from the normal growth (caused by parasites) to regard them pathologically as the result of disease, and certainly not altogether erroneously, since we know that they constitute more or less frequent exceptions. But supposing that the reciprocal relations between two animals, or an animal and a plant, were of such a character that each was dependent on the other, any deviation from the normal growth must evidently no longer be regarded as indicating disease. We must even consider the apparent abnormity as a peculiarity or character of the species, since it must necessarily occur in every individual of the species. The constancy of the causes which first led to the association of the two kinds of animals would inevitably result in the constancy of the deviation, and consequently the transformation of a pathological phenomenon into a normal character would depend solely on the uninterrupted constancy of the active causes. Now, in point of fact, several cases have long been known to us of pathological changes in animals which have become normal modifications, and the causes of which can only consist in the association of two species of animals."

Some of the cases cited by him involve transformations just as startling as any that have occurred in the nerve parasites. I will just give one instance: The Sacculina, after it attaches itself to the abdomen of the hermit crab, loses its organs of locomotion, the greater part of its muscular and nervous system, its organs of sense, and often its mouth, stomach and intestinal canal. In their place it develops long filamentary processes at the fore end of the body with which it clings, and bores through the skin of the crab into its abdominal cavity and clasps the crab's internal organs, particularly the liver, in the long entangled filaments. These slender threads are hollow tubes which open into the body cavity of the parasite, which thus absorbs nourishment by endosmosis from its matrix. In the face of such an absolute and radical transformation as this, no one can safely deny the parasitic origin of the vertebrate structure on the ground that the cerebro-spinal nerve animal has been modified out of all immediate likeness to its original.

There is one other point which I wish to emphasize for the benefit of those who may be inclined to exclaim at the absurdity of the theory of parasitism, and it is this: There is but one living matter—protoplasm; and the complicated phenomena which we now observe in connection with it have all been evolved by gradual development from its most primitive form. Consequently, whether we believe that the vertebrate organism has been evolved by some obscure and not easily conceivable process of "differentiation," or whether we accept the direct and intelligible explanation afforded by parasitism, the living matter is still the same and capable of the same modifications. The fact that the parasite for a time enjoyed a separate existence would not in the least affect its power of subsequent development, although it would predetermine approximately the path along which that development should go.

The theory of parasitism involves some important and distinctly advantageous modifications in our present view of evolution. In the first place the record is no longer in its former imperfect condition, and it becomes necessary to call in untold millions of years to our aid. We have the whole thing before us, from the eozoon to the highly specialized Anglo Saxon, and the time required for the evolution of species is well within the limits set by geology and physical astronomy. Lord Salisbury's objection that "time fails for such an operation" is no longer valid. Then it is clear that the contest for survival was subject to internal as well as external forces, while in the evolution of form the former have been supreme, especially in the case of the vertebrates. The "weeding out" action of natural selection has been exercised on types as well as on individuals. The vertebrate organism was for a long time in a state of unstable equilibrium; hence the multiplicity of forms, and the large number of types which were unable to adapt themselves to their surroundings. Had these latter types been evolved solely by the operation of the law of survival, it is hard to understand why other parallel forms, which in outward equipment were no better off, should have withstood the pressure of their environment and survived. The simpler explanation is that these unsuitable types were evolved during the perpetual oscillations between the contending internal forces. They become extinct in spite of the perfecting process of natural selection—a fact which, if it proves anything, indicates that like certain individuals they were inherently unfit, either through lack of intelligence or unwieldiness of form.

This brings us to another point which cannot be too strongly emphasized. When Darwin propounded his theory, the belief of a supreme first cause had imbued the whole intellectual world with a belief in design. Notwithstanding his magnificent effort to cut loose from superstition, his whole work shows that he was still dominated by this idea of purpose, although he arrived at it through the operation of second causes. Utility with him was the god who moulded all structural modifications, and there was no part in the organism, however insignificant, but had come there for a purpose, past or present. This idea will have to be abandoned. Utility has cut but an insignificant part in structural evolution, which has been brought about entirely by modifications of the cerebro-spinal parasite due to variations of nutrition. This last is in reality what has been called "spontaneous variation," and its operation has been entirely independent of any purpose or utility. If the organism adapted itself to its environment it did so by using what it had, not by developing something which it had not; and the extinct animals go to prove that the effort was not always unsuccessful, but that some organisms were so heavily handicapped that they had to succumb. Darwin's cardinal error lay in reasoning from the artificial back to the natural. The reading of Malthus first gave him the idea of the struggle for survival, and the achievements of the dog and bird fanciers afforded a plausible argument for the operation of "spontaneous variations;" but as a matter of fact that dire struggle for existence which exists in artificial communities has no parallel in nature, while the scrupulous and unremitting care which has produced the artificial breeds, and without which they would speedily become nonexistent, is in itself a sufficient refutation of the claim that in it we have an explanation of the origin of species.

Species took their rise outside the breeders' yard, and from causes the very reverse of selective, and the weight of current opinion to the contrary notwithstanding, it will yet be found that Darwinism has held the same relation to evolution that the theory of epicycles did to astronomy. It has expressed the problem in new terms without solving it.

Here I will leave the matter for the present, but I cannot close this article without referring to one striking fact. From the earliest ages mankind has recognized the duplex character of the human organism. Philosophers have speculated and disputed about it. Metaphysicians have dissected it with the scalpel of keenest ingenuity. Theologians have thundered, blundered and prayed over it. Theosophists have traded on it, and scientists have even denied it altogether; and yet it would seem that after all this blind semi-instructive belief is founded on a profound physiological truth; that the ego, the nerve animal, the highly specialized polype, is indeed in the body but not of it; that while dependent on the subordinate organism in all matters of nutrition, it yet maintains a separate existence; that it is in fact that hitherto unspecified entity, the soul. It is very curious when you come to think of it.

A single order for 1,000,000 pounds of smoking tobacco was a new record for that line of business recently achieved by a Virginia tobacco firm.

A PEACE MONUMENT.

THE sun always looks brightest when it breaks through the clouds after a raging storm, casting its beautiful light over the earth that still trembles from the fury of the elements; and so, when the mind is filled with pictures of terrible battles and the horrors of a devastating war, peace and the blessings it brings with it are doubly appreciated. The very conflict that gave it birth makes peace a blessed deliverance, the sudden relief from fear gives an opportunity to understand its full beauty.

This is the idea that inspired the Munich sculptor Rudolf Maison when he produced the design for a monument shown in the accompanying engraving. Whether this work will ever be given a permanent form, depends upon the approbation it wins for itself. At present Maison's design is remarkable chiefly as a truly artistic protest against the usual treatment of monumental subjects.

In order to make the terminal of the fine new Prinzregenten Strasse, in Munich, more effective, it was decided to erect a peace monument on the terrace of the Luitpold Bridge, and competitive designs were called for, but no chance was left for the exercise of inventive genius, because the conditions of the competition were very limited, calling only for a figure representing an angel of peace supported by a column. Most of the competing artists tried to obtain the best possible effect with a column as a pedestal, so often condemned from an æsthetic point of view; but Maison, one of the most gifted and best known among them, offered this design, which treated the subject in an entirely different manner. It was exhibited at the last exposition in the Crystal Palace, in Munich, where it was seen by many people. As yet Maison's work is only a sketch which needs many modifications and changes, but the thought embodied in it attracts the observer quite as much as the fresh and original execution and the strong decorative treatment.

A PEACE MONUMENT.—DESIGNED BY RUDOLF MAISON.

THE WOODEN PAVEMENT FROM A SANITARY POINT OF VIEW.

IN the Lyon Médical for September 6 we find an important article on this subject, by M. Rodet and M. Nicolas, says the New York Medical Journal. They refer at first to analyses of old wooden paving blocks made by M. Miquel, which they characterize as optimistic, and they conclude that the exceedingly favorable results arrived at by him are to be imputed to the fact that he examined the wood in a state of powder too coarse to show all the bacteria contained in it. They, on the other hand, subjected a fine powder to examination. Examining pine blocks that had been laid in Paris for several years, they found on the upper surface, after it had been washed, more than 50,000,000 microbes to the gramme (about 15 grains); at a depth of a centimeter, 84,210; at a depth of three centimeters and a half, 43,100; and at a depth of five centimeters, 51,000. In a pine pavement taken up from a Lyons street in January, 1895, in foggy weather, after a number of frosts, that had been five years and a half in use and was highly impregnated with water, 79,360,000 microbes in the superficial portion, of which 96,000 were liquefactive; 489,000 at a depth of two centimeters, of which 1,600 were liquefactive; 116,800 at a depth of four centimeters, of which 400 were liquefactive; and 423,000 at a depth of six centimeters, of which 800 were liquefactive. In another pavement in the same street, taken up during a dry spell in March, 1895, they found at a depth of a centimeter and a half 2,361,600 microbes, of which 37,200 were liquefactive; at a depth of four centimeters, 258,000, of which 13,200 were liquefactive; at a depth of six centimeters, 63,600, of which 1,200 were liquefactive; and at a depth of eight centimeters, 110,400, of which 8,400 were liquefactive.

It follows that wet wooden paving blocks contain many more microbes than dry ones, and that it is especially in dry weather that the old pavements give off their microbes. In no instance did the authors find the Bacillus coli in the deep part of the pavement. Moreover, the micro-organisms found in the blocks proved almost innocuous when inoculated upon guinea pigs. No more infective did the scrapings from the lower surface of the blocks prove. Nevertheless, the authors consider their findings to be somewhat unfavorable to the use of wooden blocks for paving. The superficial portions of them, those that are most likely to give up their contents to the surrounding air, are

abundantly impregnated with microbes, and they persist after the most careful washing.

PROF. LEONIDAS ARNIOTIS' TRAINED CATS AND DOGS.

FROM time immemorial cats and dogs have been sworn enemies, but those trained by Prof. Leonidas Arniotis are an exception to this rule. He has taught them to be real friends, and the many tricks which they perform together have delighted the audiences at the Berlin "Winter Garden," where they have been exhibited this winter.

"Sultan" is a large dog, measuring more than three feet at the shoulder, that has received many prizes. He works most conscientiously, performs his tricks perfectly, and, according to his master, is both "fearless and faultless." "Cerberus" is an English dog that has several tricks which he cannot perform in his present quarters. He is a celebrated diver and can bring up objects from a depth of 16 ft. He lives on the most friendly terms with "Pippina," a cat he rescued in Paris from the water into which she had been thrown. She rides on her friend, takes the highest barriers with him, leaves her steed at certain places and then springs on his back again under the most trying circumstances. The poodle "Faust" takes the part of a clown; he makes all sorts of blunders, upsets the cats he should jump over, and then, from shame for his misdeeds, disappears in a basket. "Follette" and "Mimisse" have a little performance that is strictly their own. Miss "Mimisse" goes to the ball, takes her place on a chair and is invited by Mr. "Follette," with many bows, to dance a polka. This performance is followed by a storm of applause.

A comic scene which follows is a triumph in animal training. "Cerberus" is chained at the left side of the stage, "Pippina" takes her place on a chair at the right, and Mr. Arniotis is seated at a well covered table in the center, ready to eat his supper. He has nothing to drink, and, as there is no one to wait on him, he is obliged to go for it himself. After he has left the stage "Cerberus" slips his collar off, climbs up on the table and eats the entire meal. As he is swallowing the last mouthful a thought comes to him of the punishment that must follow, and he looks to his friend to help him out of his difficulty. "Pippina" is then taken by the collar and set on the table, where she remains looking sad, while "Cerberus" resumes his collar. Mr. Arniotis returns, is suspicious of the unhappy victim sitting among the empty dishes, and is about to punish her, when she climbs up on her master and whispers in his ear that "Cerberus" is the real culprit. "Pippina's" innocence is established, and the audience thanks the performers with a round of applause.—Illustrirte Zeitung.

PERFORMANCES OF PROF. LEONIDAS ARNIOTIS' CATS AND DOGS IN THE BERLIN WINTER GARDEN.

THE best temperature at which to dry and bake cores has been found, by a committee of the Western Foundrymen's Association, held in Chicago, to be between 350 and 400 deg. Fah.

THE SAVING OF VANISHING KNOWLEDGE.

IT is well from time to time to take stock of our knowledge and of our methods of inquiry, to see whether we are working on sound lines. As the business man finds it necessary to periodically go over his stock and balance his books, so, too, the scientific man, especially the biologist, should perform an analogous operation, lest perchance he find out too late that he has been entering on a comparatively unprofitable line of work or has been neglecting valuable opportunities. While it is impossible to say what scientific work is ultimately unprofitable, it may not be difficult to suggest that particular subjects for investigation are of more immediate importance than others.

Let us for the moment divest ourselves of all preconceived ideas and pet fancies, so as to discover what is at the present time the most urgent need of science. In order not to complicate the question, we will dismiss the practical applications of science by admitting that they are of immediate importance. This leaves the field clear for scientific subjects which are studied solely for their own sakes.

We can, perhaps, gain a clearer view of the question by looking at it from the standpoint of our successors—What will be the opinion of the naturalist of a hundred, or of a thousand, years hence? What is the scientific work that he would wish us to have undertaken? This question is an easy one to answer.

He would not consider it very necessary for us to elucidate the structure, development or physiology of

every common animal; these matters can be done at any time. The investigation of the life in the oceans—whether on the surface, in shallow water, or in abysmal depths—can be done by him as well as by us. We may safely leave for the present the problems of the Antarctic polar basin; if this generation does not learn the secrets of the palæocrystal ice, another can and will do so.

Our future naturalist will certainly and most justly complain if we busy ourselves with problems that can wait, that he can solve as well as we, and at the same time neglect to do that work which we alone can do. Our first and immediate duty is to save for science vanishing knowledge: this should be the watchword of the present day.

Those students of botany, zoology and anthropology who have at all considered the matter, are impressed with the fact that the present is a very critical time for the native flora and fauna of many parts of the world. Owing to the spread of commerce, the effects of colonization, and the intentional or accidental importation of plants and animals, a very rapid change is affecting the character of the indigenous life of numerous districts. This is notably the case in oceanic islands, the area of which is often extremely limited, and as a consequence the native forms are the more likely to be swamped by the immigrants; but it is just those spots which are of especial interest to the naturalist on account of their isolation from the great land areas. Thus the flora and fauna of many of the districts most interesting to the field naturalist are in our day becoming largely exterminated before they have been adequately recorded. The investigation of disappearing animals and plants can, in many cases, be undertaken by us alone—and even now much has disappeared and more is fast passing away. It is, perhaps, scarcely necessary to point out that this investigation is not a matter of interest to the systematist only, but it is of great importance in connection with the problems of the geographical distribution of animals and plants which open up such fascinating vistas of the extension of continents in former ages and of their partial submergence, not to speak of the bearing of specific and individual varieties on the intricate questions of the origin of species, or the adaptation of those peculiar forms to their particular localities, and those wonderful inter-relations between plants and plants, plants and animals, or between animals and animals, and between all and their environment.

Some years ago a committee was appointed to investigate the zoology of the Sandwich Islands, and they sent out Mr. R. C. L. Perkins, who has done most excellent work. His researches in the Hawaiian group prove that quite a noticeable decrease in the indigenous fauna is taking place each season The district around Honolulu was perhaps originally the richest in endemic forms, but now introduced forms are in vast preponderance; the distinctive fauna of the plains, if there was one, has quite disappeared. Captain Cook found certain birds, for example, near the shore; of these, some are extinct, and others are to be found only in the mountains. In a letter recently received by Dr. D. Sharp, dated from Lihue, Kauai, he states: "This place has been a dead failure. The country where I camped here was a low-lying, densely covered forest bog land, at first sight a paradise for Carabidæ (ground beetles), and differing from any other place known to me. Its fauna is entirely lost forever. I turned during my stay thousands of logs, any one of which at 4,000 feet would have yielded Carabidæ; of all these there was not a single one under which Pheidole megacephala had not a nest, and I never beat a tree without this ant coming down in scores." This is an introduced ant which is overrunning the islands and which exterminates the native insect fauna. Mr. Perkins finds that earwigs alone can withstand this ant, and his only chance of collecting endemic insects is to get ahead of the ant. The area of the whole group is somewhat larger than Yorkshire. If the diminution of the fauna is so marked in such a comparatively large group as the Hawaiian Islands, how much greater must it be in the small islands!

Mr. Knight, in his entertaining book, "The Cruise of the Falcon," describes the prostrate forests of the island of Trinidad in the South Atlantic. We never can know what was the nature and extent of this vanished flora and fauna.

What is taking place in the small islands holds good to a somewhat less extent for the larger ones. In New Zealand the government is taking steps to preserve certain well-known vestiges of its ancient fauna which are in imminent danger of extermination; but it does not interest itself in the inconspicuous forms, which are subject to the same danger, nor does the New Zealand government systematically investigate the existing fauna of the group.

It is necessary that such investigations should be undertaken by competent naturalists. They should not only be good collectors, but keen observers, in fact, naturalists in the true sense of the term; for unless the work is well done, it had almost be better left undone. There are many examples of collecting being so imperfectly done as to lead to very erroneous conclusions. It takes time for a naturalist to become acquainted with the local types. The endemics do not show themselves, as usually the conditions of life are such that insects, for example, live retired lives and are not seen, while those that manifest themselves are often foreigners.

The extermination of animal life is more rapid and striking than that of plants, but what has been stated for animals must be applied to plants as well.

Not less important than the foregoing is the study of the anthropology of these districts. The Tasmanians have entirely disappeared, and we know extremely little about this interesting people. In many islands the natives are fast dying out, and in more they have become so modified by contact with the white man and by crossings due to deportation by Europeans, that immediate steps are necessary to record the anthropological data that remain. Only those who have a personal acquaintance with Oceania, or those who have carefully followed the recent literature of the subject, can have an idea of the pressing need there is for prompt action. No one can deny that it is our bounden duty to record the physical characteristics, the handicrafts, the psychology, ceremonial observances and religious beliefs of vanishing people; this also is a work which in many cases can alone be accomplished by the present generation.

The late Prof. H. N. Moseley was so impressed with this fact during his voyage on H. M. S. Challenger that he concluded his "Notes by a Naturalist on the Challenger" by pointing out that the physical conditions and fauna of the sea can be investigated at leisure at any future time. "On the surface of the earth, however, animals and plants and races of men are perishing rapidly day by day, and will soon be, like the Dodo, things of the past. The history of these things once gone can never be recovered, but must remain for ever a gap in the knowledge of mankind. The loss will be most deeply felt in the province of anthropology, a science which is of higher importance to us than any other as treating of the developmental history of our own species. The languages of Polynesia are being rapidly destroyed or mutilated, and the opportunity of obtaining accurate information concerning these and the native habits of culture will soon have passed away. The urgent necessity of the present day is a scientific circumnavigating expedition which shall visit the least known inhabited islands of the Pacific, and at the same time explore the islands which yet remain almost or entirely unknown as regards their botany and zoology; these promise to yield results of the highest interest if only the matter be taken in hand in time."

There is no difficulty in finding men willing and competent to undertake such investigations if the funds were forthcoming; experience has shown that an annual sum of at least £400 is necessary to equip and maintain one naturalist.

Here, then, is a great opportunity for the millionaire. No one doubts that the work is worth doing; it is essential that it should be done at once. Capable men are ready to undertake it—only the means are lacking.

The British Association has appointed a committee to report on this matter, of which Sir William Flower, Director of the Natural History Museum, South Kensington, is the chairman and the present writer the secretary; so there exists a machinery ready to be put in action when funds are available. Will not one wealthy man, or a syndicate of rich men, contribute to do this work for the world? The opportunity, if neglected, is lost for ever.—A. C. Haddon, in Nature.

THE CHEMISTRY OF THE CYANIDE PROCESS.

Two views have been expressed concerning the chemical reaction which takes place in this very important recent process for extracting gold from its ores. These are represented by the following equations:

$$2Au+4KCN+2H_2O = 2KAu(CN)_2+2KOH+H_2$$
$$4Au+8KCN+2H_2O+O_2 = 4KAu(CN)_2+4KOH$$

The second equation represents the view which is now generally accepted, and Bodlaender has recently shown conclusively that no hydrogen is evolved when gold is placed in contact with potassium cyanide solution. He placed finely divided gold and the cyanide solution in an exhausted retort, and after a contact of fourteen days no hydrogen could be detected. He showed, moreover, that the presence of oxygen was necessary for the dissolution of the gold, but he has found that the commonly accepted equation, the second one given above, does not fully represent the reaction, but that hydrogen peroxide is at first produced and that the reaction takes place in two stages, viz.,

$$2Au+4KCN+2H_2O+O_2 = 2KAu(CN)_2+2KOH+H_2O_2$$
$$2Au+4KCN+H_2O_2 = 2KAu(CN)_2+2KOH$$

The author proved conclusively that hydrogen peroxide is produced in the reaction, and that its formation is more abundant the more rapidly the solution of the gold takes place. When the hydrogen peroxide was removed as fast as it was formed by having calcium hydroxide present in the solution (thus producing a precipitate of calcium peroxide), the author was able to obtain about two-thirds of the theoretical hydrogen peroxide by quantitative determination.—Zeitschr. fur angew. Chem., 1896, 583. H. L. W.—Translated by the American Journal of Science.

The great importance which attaches to many of the new railway projects for London may perhaps be better gaged by the number of stations they will add to those which the metropolis already possesses, than by most other methods of comparison, says the Engineer. Some of the lines mentioned are now under construction, others are authorized, while others yet are coming before Parliament in the session just opened. The various schemes within the London area number no fewer than ten, and are, with the exception of the great trunk line of the Manchester, Sheffield, and Lincolnshire Railway, electric lines. They are as follows:

		Stations.
1.	Central London Railway	14
2.	City and West End	14
3.	Hampstead, St. Pancras, and Charing Cross Railway	10
4.	City and South London: Extensions to Clapham and to the Angel, Islington	8
5.	Great Northern and City	5
6.	Baker Street and Waterloo	5
7.	District Railway Deep Level	3
8.	Piccadilly Circus and Kensington Railway	2
9.	Waterloo and City	2
10.	Manchester, Sheffield, and Lincolnshire	1
		64

If, however, we add to the number of projected railways the Regent's Canal, City, and Docks line—whose name was in recent years altered for convenience sake to the "North Metropolitan"—the number of stations must be increased to 79; for fifteen stations were proposed on the twelve mile course of that east to west route. But that railway is now in a state of suspended animation, although it may be noticed that it is still marked on the Metropolitan District Railway map as in progress.

SELECTED FORMULÆ.

Ink for Marking Lantern Slides.—The following formulæ are suitable for making white ink for marking lantern slides with an ordinary pen. If oxide of zinc is ground in gum water until quite smooth, it will form a fine, rich white; the proportions are:

Pickled gum arabic	1	part.
Water	30	"

Grind enough zinc oxide with the above to give the depth required.

Another useful formula is the following:

Chinese white	1	oz.
Gum arabic	2	dr.
Alcohol	1	"

Water enough to bring to the consistency of cream. Dissolve the gum in a couple of ounces of water, and then stir it with the Chinese white until a smooth paste results. When well mixed, add water gradually with frequent stirring, until sufficiently thin to flow freely from the pen. Occasional trials will determine when this point is reached. Finally, add the alcohol.—Photo. News.

Liquid Fire Extinguisher.—1. Make the following solutions:

(1)	Ammonium chloride	200	parts.
	Water	20,000	"
(2)	Alum calcined and pulverized	350	"
	Water	10,000	"
(3)	Ammonium sulphate, in powder	3,000	"
	Water	500	"
(4)	Sodium chloride	2,600	"
	Water	40,000	"
(5)	Sodium carbonate	350	"
	Water	5,000	"
(6)	Liquid water glass	4,500	"

Mix the solutions in the order named, and to the mixture add 20,000 parts of water.

2. Crude calcium chloride	20	parts.
Salt	5	"
" dissolved in water	75	"

Keep at hand and apply with a hand pump.

3. Solution for hand grenades: Fill thin, spherical bottles of blue glass with a solution of calcium chloride, sal ammoniac or borax.—Pharmaceutical Era.

Limonated Seidlitz Powders.—This is a highly approved and very palatable form of Seidlitz powder.

Powdered tartrated soda	12	ounces.
Bicarbonate of soda	4	"
Powdered tartaric acid	$3\frac{1}{2}$	"
Powdered white sugar	16	"
Essence of lemon	30	drops.

The powders should each be carefully dried on separate plates or sheets of paper, and all reduced to a very fine powder. A little gentle heat may be used in drying. Rub the essence of lemon with the sugar in a mortar and then pass it through a sieve. First mix the tartrated soda with the lemon flavored sugar, then add the bicarbonate of soda and well mix, and then the tartaric acid and mix the whole well together in a mortar, and pass once or twice through a sieve to insure a thorough mixture, and bottle in perfectly clean and dry bottles, securely cork, and, if not for immediate use, seal. Perfect dryness is necessary or the whole will become a solid lump. For use, stir a dessertspoonful in about a tumblerful of spring water.—Mineral Water Trade Review.

Jewelers' Cement.—Dissolve over the water bath fifty parts of fish glue in a little strong alcohol. Add four parts of gum ammoniac. Separately dissolve two parts of mastic in ten parts of alcohol. Mix the two solutions, and keep them in well stoppered bottles. In order to use this it must be warmed over the water bath.—Bulletin of Pharmacy.

Shellac Liquid Blacking.—(1.) To one gallon rectified spirit is added 21 drachms blue aniline and 31 drachms Bismarck brown aniline, the solution of the last two being effected by agitation for eight to twelve hours. After the solution is completed the mass is allowed to settle, and the liquid portion is drawn off by spigots above the sediment and filtered if necessary. The alcohol is placed in the apparatus first, then the colors and the mixture agitated every hour for a space of ten or fifteen minutes. Of this liquid one-fourth gallon is added to 1 gallon of rectified spirit, and in this are dissolved 11 ounces of camphor, 16 ounces Venice turpentine, 36 ounces shellac. To 1 quart benzine add $3\frac{1}{2}$ fluid ounces castor oil and $1\frac{5}{8}$ fluid ounces boiled linseed oil. The two solutions are then united by agitation, but should not be allowed to stand over two days in any vessel of iron or zinc, as in the presence of the gums the colors will be decomposed.

(2.) Shellac	50	grains.
Venice turpentine	40	"
Solid blue black "B"	15	"
In a mixture of		
Alcohol	2	fl. ounces.
Gasoline	6	fl. drachms

—Pharmaceutical Era.

To Keep Silk Handkerchiefs White.—In washing silk handkerchiefs care should be used to prevent their turning yellow. A silk handkerchief should never be boiled nor have soap rubbed upon it. Make a lather of finely shredded white soap and hot water. Clean the handkerchiefs and rinse them in plenty of cold water to thoroughly remove all the soap. Press out all the moisture possible and dry quickly in the sun, ironing them while they are still damp, but not wet.

Unfermented Wine.—Müller, in the Apotheker Zeitung, has applied the principle of Pasteur's treatment of wine for the preservation of grape juice and other fruit juices without fermentation. He finds that when the freshly expressed juice is heated in bottles to a temperature of 60° to 70° C. for fifteen minutes, the yeast cells and other fermenting agents are rendered inactive. The juice can then be kept in well closed bottles for several years without fermenting. To obtain the juice clear, it must, however, be filtered, an operation which is easily carried out, as the heating will have coagulated the mucilaginous substances, causing turbidity. Filtration may be carried out immediately after heating the juice, or after some time, but in any case, the filtered juice must be again heated in bottles to the same temperature originally applied.

ENGINEERING NOTES.

Australia had last year 9,760 miles of railway open. The capital expended on them has been $537,000,000. The net revenue over working expenses is 2¾ per cent.

The best steamship passage across the Atlantic during 1896, according to the showing of the Cunard Company, was that of the Lucania, which, leaving Liverpool on August 15, covered the distance between Queenstown and New York, 2,783 knots, in 5 days, 8 h. 45 min. The best homeward passage was made by the same vessel in 5 days, 10 h. 34 min., leaving New York on August 29.

Already a portion of the preliminary work for the Exposition at Paris has been allotted, the first contract being that for fencing in the grounds on the right bank of the Seine, near the Pont des Invalides, and the second for grading and foundation work. Two of the French co-operative societies were bidders for a portion of the latter work, but they were decidedly underbid by a private firm which secured the work.

A recent report of the trustees for the Brooklyn Bridge states that up to December 1 last ten hauling cables had been in use, of which eight had been worn out and removed. Seven of the eight cables had lives of from 356 to 607 days, the other, having had lighter work to do, lasting 1,140 days. The two last removed had hauled average loads of 323·3 and 398·7 tons respectively, the mileages being 111,136 and 100,268 miles.

For certain purposes aluminum bronze is superior to steel, as it appears little subject to fatigue. Cartridge shells of this material have, it is stated, been fired ninety times in succession, and a rifle firing pin struck 120,000 blows without a change occurring in its molecular condition. It can be drawn into tubes, but is as difficult to deal with as steel. The strength of the drawn tube not annealed reaches 96,000 lb. per square inch.

The total number of vessels launched in Great Britain and Ireland during 1896 was 751, of which 696 were merchant vessels, with a gross tonnage of 1,159,751 tons. This is the greatest tonnage launched in any year since 1890, when it was exceeded. The number of warships launched was 55 with a displacement of 163,958 tons, as compared with 148,111 tons in 1895. Of these 55 vessels, 8 with a displacement tonnage of 66,370 tons were built at government yards, the remaining 47 being built at private yards.

A bridge clearance indicator is suggested for the Brooklyn bridge, says the Engineering News. This indicator would be modeled after those showing the height of the tide in New York and the Delaware harbors. This is a dial, 30 ft. in diameter, carrying figures, each 3 ft. high, and a pointer connected with a float, and another pointer at the center of the dial shows whether the tide is rising or falling. The pointer tells the exact state of the tide and both can be seen, with a glass, at a distance of two miles. In the case of the bridge the pointer would indicate the clearance, in feet, under the structure, and thus possibly save damage to the top rigging of ships.

During the first eight months of 1896, which is the latest period for which full returns are available, the average amount of water supplied daily per head of the population in the five following towns was: Manchester, 25·8 gallons; Liverpool, 28·3 gallons; Birmingham, 24·1 gallons; Leeds, 34·9 gallons; London, 38·1 gallons. If the domestic consumption only be taken, the difference in favor of London is still greater, as the large manufacturing towns use a larger quantity per head for trade purposes. For instance, in Leeds, which comes nearest to London, the average domestic supply is 25·3 gallons, against 30 gallons in London.

The largest hydraulic cylinder ever made in this country has recently been finished in the Homestead works of the Carnegie Steel Company. It was made for the large hydraulic press in the armor plate department. The original cylinder of the press, which had been made in England, was in three pieces, and when it broke it was decided to make a new one in one piece. Its dimensions are 11 ft. long and 6 ft. inside diameter, and its finished weight 80,000 lb. It was made of nickel steel in a sand mould, the heats of two open hearth furnaces being required for the casting, which weighed 90 tons in the rough. It was bored in a machine specially built for the purpose, and when the boring was completed, it is said that not a blowhole nor blemish was found in it.

Mr. John Medway, Superintendent of Motive Power of the Fitchburg Railroad, has made a series of tests to determine the relative non-conducting qualities of the three kinds of boiler covering used on that road. The locomotives carried a uniform pressure of 130 lb., and the room temperature was uniform. Four readings of thermometers were taken at intervals of five minutes respectively on the bare boiler shell and outside surface of lagging. From the difference in the average temperature of each position was found the percentage of heat radiation through the lagging. The results were as follows: Asbestos air cell, 1 in. thick, 50·9 per cent.; magnesia blocks, 1½ in. thick, 51 per cent.; asbestos plaster, 1¼ in. thick, 61 per cent. Air cell covering is made by folding over portions of asbestos paper, thus forming an air passage from one end of the section to the other; care is necessary in applying this covering to make every joint airtight.

The mileage of track of the Pennsylvania Railroad system at the end of 1896 aggregated 12,859·97 miles, distributed as follows:

	West of Pittsburg, Miles.	East of Pittsburg, Miles.	Total, Miles.
First track.......... ...	2,762·41	4,138·26	6,900·67
Second track....... ...	508·88	1,180·72	1,689·60
Third track...........	35·97	350·12	385·09
Fourth track	18·19	256·80	274·99
Company's sidings.....	1,343·39	2,255·91	3,599 30
Total	4,669·16	8,190·81	12,859·97

ELECTRICAL NOTES.

Of the central electric power stations erected or commenced in Germany during the year 1896, 40 per cent. have been on the three-phase or alternating systems and 60 per cent. employ continuous current.

According to the London Electrical Review the number of eight c. p. lamps, or their equivalent, in some of the leading European cities is as follows: London, 1,300,000; Paris, 500,000; Manchester, 92,000; Glasgow, 70,000; Liverpool, 54,000; Edinburgh, 43,000. Of the total capital invested in electric lighting installations, more than one-half falls to London.

According to L'Echo des Mines, of Paris, the longest suspended wire in the world is in Switzerland. The wire has just been stretched across the Wallenstadt Lake in the Canton of St. Gall, by the Swiss telephone administration. This wire is suspended from two iron towers erected for the purpose, the distance between these supports being 2,400 m. At the lowest point it is 40 m. above the water. The wire is of steel of the best quality and is 2 mm. in diameter.

In order to deposit copper on aluminum by electrolysis, M. Margot, in the Archives des Sciences, Physiques et Industrielles, recommends that the aluminum be first bathed in a solution of an alkaline carbonate, then washed in running water and immersed in a hot 5 per cent. solution of hydrochloric acid. A second washing in pure water should follow, and then the article should be immersed in a dilute and slightly acid solution of sulphate of copper, from which a slight deposit of the metal will take place. A third washing to remove all traces of chlorine is then in order, after which the real deposit may be effected by electrolysis.

According to the London Electrical Review an interesting process is now being conducted at Charlottenburg, Germany, by M. Mehner, by means of which ammonia and nitrides are produced. Oxygen compounds of such elements as boron, silicon, magnesium, titanium and vanadium, capable of combining with nitrogen at high temperature, are exposed to the heat of an electric furnace in the presence of free nitrogen and carbon. A high tension current must be employed and a jet of sand blown in while generator gas is introduced; on entering the hot zone of the electric furnace the sand is said to evaporate and then acts as desired. Nitrides thus manufactured may be treated with steam to obtain the ammonia and an oxide from which a nitride may be reformed as before.

How much actual time is necessary to transfer a telegraphic message from London to Valparaiso, Chile, was the question propounded by some South American editor last summer. The reply was furnished by a special communication, an arrangement being made with the telegraph and cable companies to keep open the wires and get the telegraphic results of a recent sporting event to Valparaiso with the least possible delay at the intervening stations. Ten minutes before the message was to be sent the wires were cleared along the entire distance, and all the ordinary communications through the cables were suspended. At the given astronomical time the dispatch was sent from London to Carcavellos, whence it was transferred through a submarine cable to Pernambuco, and from there the Brazilian coast cable conducted the message to Buenos Ayres, where it was dispatched over the South American transcontinental telegraph line, arriving at Valparaiso fifty-five seconds after leaving the London office, although the distance it had to travel in this short space of time amounted to almost 10,000 miles, and the eight words of the message had to be repeated four times.

The Rouen tramways are the most important in France worked by electricity, having a length of 23 miles, says the Engineer. Those of Lyons, which come next, are but little over 10 miles long. The company was only authorized to make use of electric power on February 1, 1895, and have now got the system fairly to work. The Thomson-Houston plant has been adopted, with overhead wires and a return circuit through the rails. The central station has at present two four-pole dynamos, giving each 300 watts, and a third giving 200 watts. All are belt driven. The line potential is 550 volts. The engines, three in number, are of the Corliss type, having cylinders about 22½ in. in diameter by 3 ft. 11¼ in. stroke. They give some 300 to 400 horse power. The flywheels are 18 ft. 9 in. in diameter and weigh 20 tons. The line consists of a copper wire 0·325 in. in diameter, supported by carrier wires running across the streets. The poles, which are of steel, number 1,200. The rails weigh 78½ lb. per yard, and are laid to a 4 ft. 8½ in. gage. They are bonded at the joints with a double wire of copper 0·31 in. in diameter. The maximum grade is about 5 per cent. and the sharpest curve of 66 ft. radius. The cars will seat 40 persons, and weigh 7 tons complete.

The electric rack railway up the Jungfrau is about to be commenced, and the Revue Generale des Chemins de Fer gives the following information concerning it: The maximum grades will be 25 per cent. and the minimum radius of curves is fixed at 100 m., or 328 ft. The motive power will be furnished by two waterfalls, with a combined capacity of 4,500 horse power. The electric conductors will be overhead, and the general arrangement of the roadbed will be the same as that adopted on the Mont Saleve electric rack railway near Geneva. The power plant will be sufficient to keep three trains moving over the road with a combined capacity of 200 passengers. The estimated power necessary is 1,400 horse power, divided as follows as to use: For traction, 667 horse power; lighting the tunnels, 50 horse power; lighting the carriages, 8 horse power; heating the carriages, 120 horse power; lighting the stations and handling the elevators at the terminus on the Jungfrau, 200 horse power; and for loss in transmission, 380 horse power. The total length of the line will be 12,260 m., or 7·6 miles, and the line leaving Petit Scheidigg with an altitude of 2,064 m. above sea level, reaches 4,093 m. at the foot of the elevator at the summit, the total rise in the 7·6 miles being 6,555·32 ft. The speed is limited to 5·3 miles per hour, and the trip to the top will consume 96 minutes. There will be five intermediate stations. The estimated cost is $2,000,000 and the estimated annual receipts are $144,400, of which $134,200 is to come from passengers.

MISCELLANEOUS NOTES.

An experiment with cordite at Woolwich recently shattered a church and a number of shops in the neighborhood, and broke windows, tore down telephone wires, and alarmed the country for ten miles around. A case of cordite was fired to see what the effect would be on twelve other cases placed at some distance. They contained 1,400 pounds of the explosive and made a hole fifteen feet deep and twelve feet wide, sending earth and stones to a distance of a mile.

Speaking of the rumor that American paper mills on a large scale are to be established near London, Industries and Iron remarks that there is no reason why such an enterprise should not succeed. "English paper makers," it says, "have for years striven in vain to manufacture a paper possessing the qualities of an American printing paper, and which are so highly prized by the printer and book binder, while it is notorious that during the past few years a very large and increasing trade has been developed in the export of American newspaper to this country."

According to La Medecine Moderne, Dr. P. Penta has studied the fingers and toes of 4,500 criminals, and finds a deficiency in the size or number of toes quite frequent among them, although very rare among ordinary men. He has also observed that prehensile toes, marked by a wide space between the great toe and the second toe, is a condition quite common among criminals, also a webbed condition of the toes, an approximation to the toeless feet of some savages. The little toes are also rudimentary in many cases, showing a tendency toward the four-toed animal foot; but the most common of all the abnormalities was the webbed condition of the toes.

The Chamber of Commerce Journal of London has the following: Most of the soap factories in Greece—which number thirty-seven—are to be found at Zante, some working all the year round and others only during certain months. The annual production of common soap is about 6,500,000 okes, of which three-fourths is consumed in the country, the remainder being sold to Turkey, Egypt, Bulgaria, Roumania, Austria and the United States. Altogether the industry employs 480 hands, whose wages vary from three to five drachmas per day. Native olive oil is used for the manufacture. For some years past the Grecian soaps have effectively competed with similar manufactures on foreign markets, they being preferred to the common soaps manufactured in Smyrna, Mytilene, Syria, and even in certain European countries. The annual exports exceed a million okes.

Doubtless few know that the New York Journal of Commerce originated what is popularly known as a newspaper extra. When this occurred times were troublesome in Europe, and the great revolution of 1830 was approaching. Naturally America was anxious for early news, and all the newspapers of New York equipped small boats that cruised about the harbor, waylaying the large packet vessels arriving from abroad to get the tidings. The Journal of Commerce conceived the plan of sending out a small schooner to intercept the packets two or three days ahead of their arrival. The originators of the plan were laughed at, and told that it would in the end ruin them. Results proved otherwise, however, and when the semaphoric telegraph announced their schooner in the offing, and later coming up the bay, the crowd would gather around the office of the paper. They had to wait until the extra evening edition was ready, and then one of the partners would sometimes read the news aloud to hundreds of citizens, while thousands of copies were sold. This schooner was the first American news boat of any size.

Oak weighs 55 pounds to the cubic foot, yellow pine 42 pounds, white pine 30 pounds, and cork only 15 pounds. Carpenters use ¾ to 1¼ pounds of nails to case and hang a door, ¾ to 1 pound to case a window, 2¾ to 3½ pounds to put up 1,000 feet of joists, rafters or scantling, ¾ to 1¼ pounds to put on 1,000 lineal feet of baseboard, 18 to 21 pounds to nail on 1,000 feet of bevel siding, 14 to 16 pounds to lay 1,000 feet of 6 inch flooring, 18 to 21 pounds to lay 1,000 feet of 4 inch flooring, 24 to 36 pounds to fasten 1,000 feet of inch boards, 5 pounds of 4 penny or 3¾ pounds of 3 penny nails to lay 1,000 shingles, and 5¾ pounds of 3 penny fine or 5 pounds of 2 penny nails to fasten 1,000 lath. The variations in the amounts of nails used are governed by the sizes employed by different carpenters. During the process of drying a southern pitch pine wood stick 18⅜ inches long shrinks to 18¼ inches, spruce from 8½ to 8⅜ inches, white pine from 12 to 11⅞ inches, yellow pine from 18 to 17⅞ inches, Canadian cedar from 14 to 13¼ inches, elm from 11 to 10¾ inches, English oak from 12 to 11⅜ inches, and pitch pine from 10×10 to 9¾×9¾ inches. Woodworkers need to keep the proportions of shrinkage well in mind, says the American Woodworker.

The remarkable light which has been brought forward in Germany, and known as the Durr light, is declared by the Railway Review to be equally capable of use for interior illumination. It is originated by automatic evaporation and overheating of the vapors from ordinary lamp petroleum; the vapors being converted into gas, when burned yield a light of from 3,500 to 14,000 candle power. The apparatus consists of a tank containing the supply of petroleum, which is removed sufficiently from the burner to avoid all danger of fire from the flame. The oil is conducted by drops into a burner of special construction, after the latter has been heated for about five minutes by means of oil which is burned in small heating pans furnished with the apparatus; behind the burner from which the flame issues there is a second burner, which, after the heating of the pans has been removed, continually produces the vapors and heats them to a high temperature, at the same time completely surrounding the first burner with a strong flame. This arrangement is said to make the extinction of the light an impossibility, even in the strongest wind. Fresh air is drawn in between the burner and the external cylinder by the force of the flame rushing out, and, by using this air in the burner, a smokeless flame results, on account of the air supply being heated. The oil used is ordinary 100° coal oil, the consumption of which is about 1¾ pints per 1,000 candle power.

PLATE SHEARING MACHINE.

WE illustrate herewith a steam shearing machine of special design made by Messrs. Joshua Buckton & Company, of Leeds. The machine, says Engineering, to which we are indebted for cut and copy, is of large size and of exceptionally strong construction, having been designed and patented by Messrs. Buckton more particularly for cutting up into conveniently sized pieces curl one part of the severed sheet or plate, and ordinary shears are so arranged that the strip cut off is the bent part. This is the most convenient arrangement, because the strip is mostly scrap. In shearing plates to make a pile for blooms in ordinary shears, the curling of the strips renders them inconvenient for piling, as will be readily understood. The parts have to be flattened out roughly, and require to be tied together by wire before being placed in the heating furnace. Even

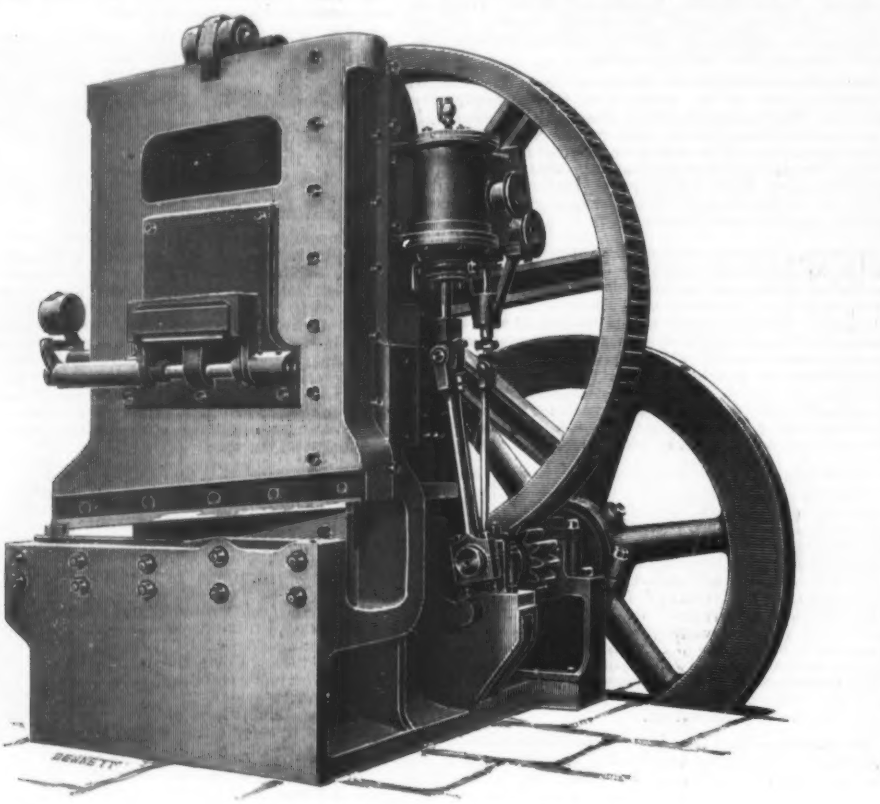


PLATE SHEARING MACHINE.

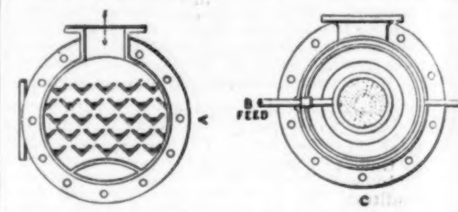
for piling the iron plates taken out of old ships when broken up. The particular machine illustrated will shear plates up to 72 in. wide and 1¼ in. thick. As will be seen, it is driven by a single steam cylinder, having a diameter of 12 in. and 15 in. stroke. The crank shaft pinion drives a shrouded wheel which gears down so as to give the reciprocations of the shears to those of the piston as one to six.

The special point in the design is that the knives are so arranged as to cut the plate and leave the strips flat. As is well known, any shearing action tends to bend or then the piles are often difficult to deal with through the cogging rolls. So far is this the case, that it has often been a profitless job to use the old plates at all for this purpose. These shears, however, give a flat strip, because the tendency to curl is thrown on the body of the plate and not on the strip, and the broad plate is stronger to resist the action and to recover from it. Old marine boiler shell plates are cut up in this machine, and such a plate up to 6 ft. wide may be cut into straight flat bars 6 ft. long and from 4 in. to 15 in. wide, each flat bar being cut off complete at one stroke. Also by using open mouthed blades long plates may be split continuously along their whole length, at 15 in. from the edge, as in ordinary shearing.

BAKER'S OIL SEPARATOR, FEED WATER HEATER, AND SOFTENER.

THE form of apparatus which is capable of thoroughly separating oil, grease, and dirty water from exhaust steam ought to be equally efficacious in separating water from live steam. Exhaustive trials have been conducted at Sibley College, Cornell University, U.S.A., on six of the best known forms of this class of apparatus, and during the trials it was demonstrated that to produce the best results in separators it is necessary to break up the main current of steam into several minor channels, to change the direction of these minor currents and to provide in the separating chamber corrugations or ducts, for immediately leading away the deposited water or grease, in order to keep it from contact with the incoming steam, which might otherwise reabsorb, or carry forward in suspension, a certain portion of the grease or impurities previously extracted.

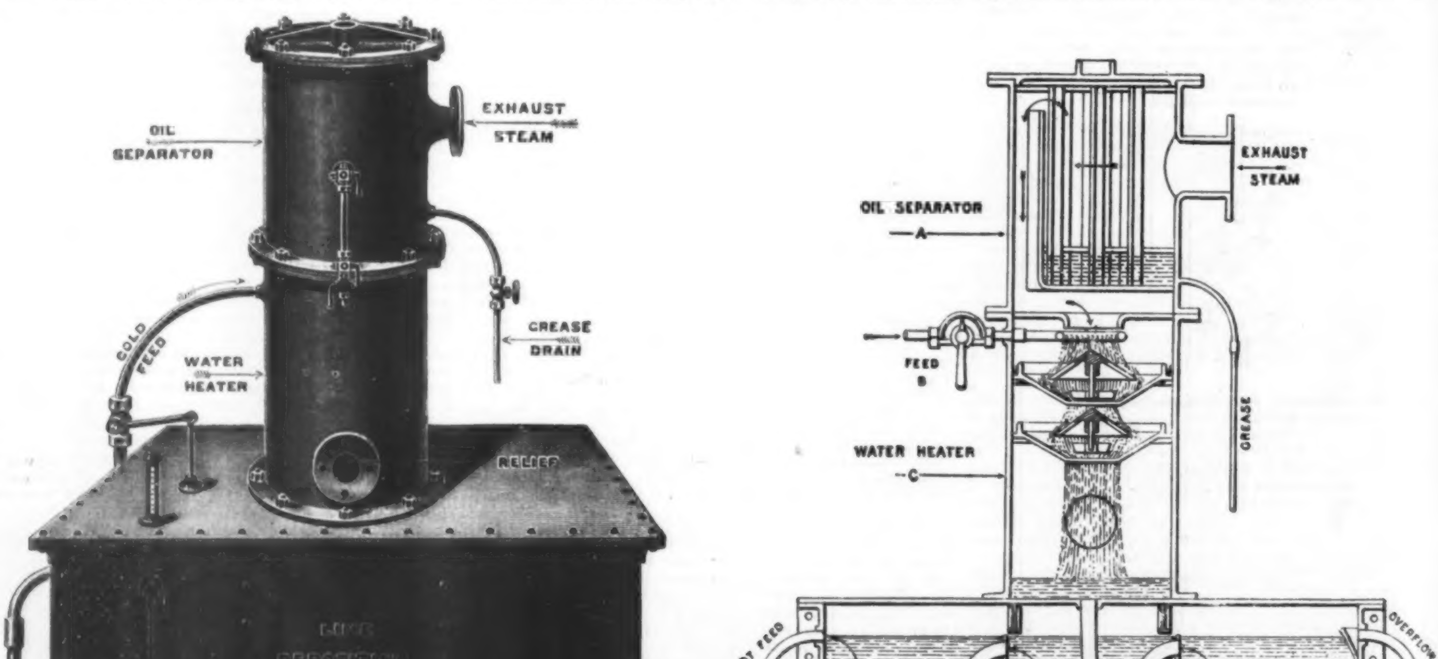
The separator, of which we give below two illustrations, accomplishes, it is claimed by the inventor, Mr.



Baker, Huntriss Row, Scarborough, the conditions named, even more completely than the examples of which trials were made. In this pattern, the live or exhaust steam upon entering the separator, instead of being caused to impinge upon a "dead wall," or flat, baffling surface, immediately opposed to its course, as is the case in most separators, is allowed to expand in a clear space left for that purpose, and is then divided into numerous smaller currents, between rows of vertically placed angle irons, in the channeled surfaces of which the water and grease are deposited, which then pass downward through a false bottom to the well of the separator, quite out of contact with the passing current of steam. The contents of the well are discharged continuously, or, when necessary, by a drain pipe or small pump. This form of separator is specially applicable to quick-running engines, to long steam pipes, and generally, to prevent water from entering cylinders, or grease from entering boilers or condensers.

A special form of oil separator for marine engines is also illustrated in Figs. A and C, in which the rows of angle irons for arresting grease are arranged horizontally, the deposited grease and water flowing from the ends of these channels, and gravitating to the covered well or lower part on the separator, from whence it is led away to a cistern, or ejected by a small pump.

The exhaust steam economizer and water softener is in its complete form a combination of the oil separator, the water heater, and a lime depositing tank, and is designed to utilize purified exhaust steam for heating and softening feed water, the heating process liberating a great portion of the lime contained in the water.



OIL SEPARATOR, FEED WATER HEATER, AND SOFTENER.

The steam is brought into actual contact with the water to be heated, which is injected into the heating chamber in finely divided spray issuing from a perforated tubular ring. The water, after being intimately mixed with steam, gravitates over a series of cones and tapering dishes. The carbonate of lime is liberated in an insoluble form, and is deposited in the tank below the heater, in which a special arrangement of partitions and pipes, shown in the illustration, insures, it is claimed, the complete separation of solid matter. It is not claimed that sulphate of lime is deposited in this apparatus, unless soda be employed, but without using any form of chemicals, the nature of the lime remaining in the feed water is so changed, probably by the withdrawal of its plastic ingredients, that no adherence of the deposit occurs, there is no actual incrustation of the boiler, and the small quantity of solid matter found when cleaning the boilers is powdery or soft, and easily removed by brush or scraper. At the Irton pumping station of the Scarborough Waterworks, the boiler feed water passing through this apparatus is supplied to the boilers at a temperature of 210° Fah., and one man is now able to clean out one boiler in a little over a day after three months' day and night steaming, whereas that operation formerly occupied three or four men nearly a month. Where exhaust steam is available, the saving of fuel effected by using this apparatus, as compared with the quantity used with cold boiler feed, is estimated at from 20 to 30 per cent., and a large volume of boiling water is produced for washing and manufacturing purposes.

The inventor is Mr. W. J. Baker, C.E., of Scarborough, and the proprietors of the patent are the "Economic Steam Appliances Company," of Huntriss Row, Scarborough.—London Engineer.

THE FOURTH CYCLE EXHIBITION AT PARIS.

CYCLING is becoming more and more the cheap sport par excellence. Not only has the price of a good bicycle dropped to $75, but, further, no notable change has been made in two years to force the owner of a machine to discard it for another for the sake of fashion. The style of the 1895 machines was not modified in 1896, and, so to speak, classified itself in 1897. However, as fashion attacks everything terrestrial, we note that during the next season the cyclist will not be "in style" unless his machine is provided with two equal wheels of 28 inches diameter at the most (some manufacturers, even, reach the minimum of 24 inches), and unless the cranks, that were formerly made 5½ inches, measure a good ⅜ of an inch more. We may add that every year that deplorable habit of suppressing the brake is becoming more and more common. The fatal accidents that this copying of the racing machine causes every month cannot, it seems, prevail against such an imprudence.

Some important improvements in the lines established have this year been introduced by the English and French houses of Humber and Rochet. The first has rightly judged that the rear of a bicycle undergoes, on the chain side, stresses that are much greater than those of the opposite side, which really serves only as a prop, and that, although the flexion of the frame at this part is not perceptible to the eye, it is nevertheless prejudicial to the best work possible of the legs. It has consequently been strengthened by a second tube (Fig. 1, No. 1), the back tube that, on the chain side, unites the crank hanger and the axle of the driving wheel.

The Rochet establishment, which for the last few years has made a specialty of improving the crank hanger, the part that might be called the heart of the bicycle, has patented a new hanger that constitutes one of the rare innovations of the fourth exhibition. This hanger (No. 2) is called "the axleless," in the sense that it consists solely of a case, A, in the interior of which are screwed, each on its side and in opposite directions, the cranks, B and B, until they block each other, the rolling taking place in the very heads of the cranks. It results from this arrangement that the hanger is as narrow as possible, the space between the pedals not reaching four inches; and it results, further, that, in case of a crank getting out of true, it will suffice to unscrew the piece that is out of order without touching the regulation of the hanger, that every key, and consequently all unkeying, during the course of a spin on the road, is suppressed, and that, finally (what is an essential thing), the sprocket is brought nearer to the vertical center of the hanger. The chain exerts its traction within the rolling, in the line CD, and no longer produces a wedging of the axle upon the balls habitual to sprockets working outside of the line of rolling. At the same stand there was exhibited a pedal adjustable to all sizes of soles, through a simple arrangement that is well explained by No. 3 of Fig. 1, and that presents, besides, the appreciable advantage of being proof against dust, that born enemy of the bicycle, as the wind is of the cyclist.

Wind and dust are terribly powerful natural brakes, but they have the disadvantage, regarded as brakes, of being neither constant nor instantaneous, and although, as we have said, the brake is becoming more and more proscribed in cycling, there are nevertheless cases (in mountain climbing, especially) in which it is agreeable as well as prudent not to rely upon the legs alone in order to avoid the accidental speed of an express train. Here we have, then, two extra powerful brakes —that of Cottereau and that of Jussy (Nos. 4 and 5). The first acts at once upon the steering wheel through friction upon the rubber tire, upon the pedal hanger, and upon the hind wheel through drums fastened in leather collars. A simple pressure of the hand upon the brake lever suffices to produce this triple effect. The arrangement of the Jussy brake utilizes the rider's muscular parts, which usually work merely as cushions. The cyclist bends over a few inches on his saddle, and, thanks to the rod curving or cushion seen above the driving wheel, the wheel is blocked.

The Loma fork is a guarantee given the bicyclist against the breakage (always serious, but now rare) of the head of the fork that holds and guides the steering wheel. As shown by No. 6, it consists of an ordinary fork into the head of which are introduced: (1) a tubular piece, which, through two plates, bears against the branches, and which is brazed to it; and (2) a tubular piece that enters the first and is brazed to it and that likewise carries two plates that bear against the branches. The result is that the branches of the fork are held by three rows of plates each of which consolidates the other.

A very original transmission is the one exhibited by Rouxel & Dubois, and which is represented in Fig. 1, No. 7. It consists of a large and a small sprocket connected by a chain, as usual, but the latter does not

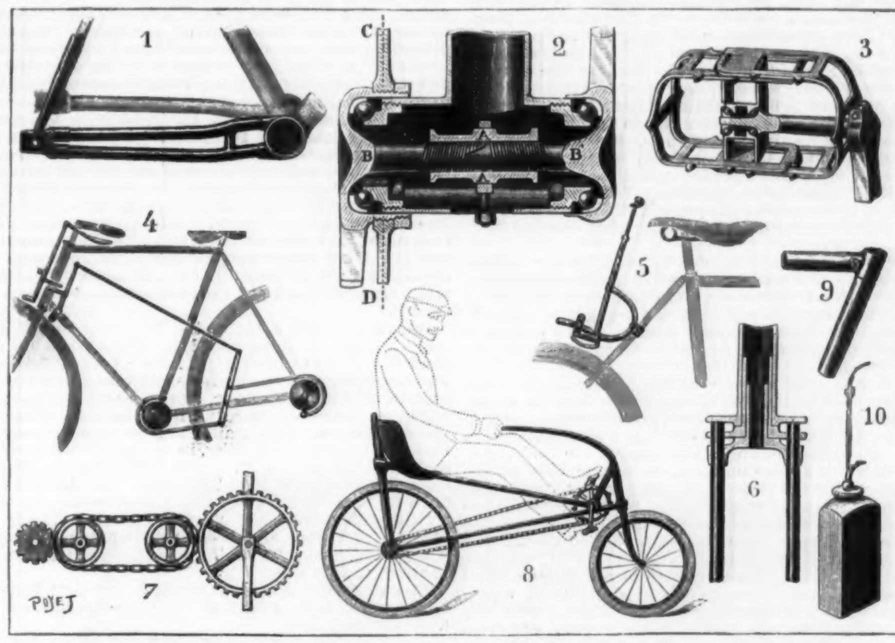


FIG. 1.—SPECIAL ARRANGEMENTS OF THE PARTS OF BICYCLES.

FIG. 3.—VARIOUS ACCESSORIES FOR BICYCLES.

FIG. 2.—THE SOCIABLE BICYCLE.

FIG. 4.—THE VINCENT BICYCLE PACKING DEVICE.

here roll over the sprockets, but over two small loose wheels that put it in tangency with the usual large and small sprocket. It thus engages at once only with an entire tooth of each sprocket, instead of ten or twelve, and thus reduces by so much the losses due to friction. Let us remark that this curious transmission, leaving the driving wheel outside of the chain, greatly facilitates the dismounting of it in case there is an urgent need of repairing the rubber tire.

Such are the principal improvements or alterations that the last cycle exhibition indicated in the very basis of the known bicycle. As to alterations in form, we shall limit ourselves to mentioning the one proposed to us in the "Normal" bicycle (No. 8), and which is made with good intentions. In making the driving wheel carry the greater part of the weight of the rider's body, in firmly sustaining his loins and in lowering the saddle so as to allow him to put his feet upon the ground without dismounting, the inventor has followed the dictates of common sense. The only thing wanting in this machine doubtless is the proof of speed that tracks alone can give. Will the "Normal" ever beat the record of the present time? It is, at the most, a machine for pleasure riding that the inventor has sought here.

The "Sociable" bicycle (Fig. 2) has no other pretension than to put the two riders of the same machine, not one behind the other, as in a tandem, but alongside of each other, so that they can indulge in sociable conversation without turning around. The length of the machine does not exceed that of one designed for a single rider.

If we now examine the new accessories that have been designed for the 1897 bicycles, we shall find that here especially the ingenuity of inventors and manufacturers has put itself to the test, and that changes in detail, whimsical or practical, swarm, so to speak. Sometimes it is a mere nothing, as in the case of the Humber saddle rod (Fig. 1, No. 9), which consists of two simple pieces at an angle, and which, according to the inclination necessary to the cyclist, assume all the positions desirable. But this bagatelle has an extreme importance from the usual view point.

Here again we have some large and small accessories of a useful nature: (1) an oil can (Fig. 1, No. 10), whose neck may be elongated at will in order to reach the most inaccessible lubricating holes; (2) an American parcel carrier (Fig. 3, No. 1), which opens and closes like an umbrella; (3) a small foot warmer (Fig. 3, No. 2), which is mounted upon the pedals for the protection of the feet of ladies sensitive to cold; and (4) a photocyclist pump and a cyclopod, the one completing the other, for those still too rare amateurs of cycling and photography combined.

The cyclopod is a movable foot of variable elongation, which, when the bicycle is rolling, is folded along the frame (Fig. 3, No. 3), but makes a tripod with the wheels when the moment has come to take a photograph. The photo-cyclist pump is an ordinary pump lying upon the handle bar, and which may be raised vertically and be elongated so as to support a camera.

For the ascent of declivities, two methods are proposed to us: (1) the purchase of a bicycle called the "Cotiere" (Fig. 3, No. 4), of which the front alone is modified in the sense that, under the handle bar, there is placed a lever, which, through a rod, actuates a small toothed wheel that gears with the hub of the steering wheel, so that it suffices to grasp the handle bar and lever and tighten them like the jaws of a pair of pincers in order to furnish a supplementary work to aid in the ascension of the slope; (2) the purchase of what is called the "Hercules" girdle (Fig. 3, No. 6), which rests against the bones of the pelvis and is fastened in front to the horizontal tube of the bicycle, and that gives the cyclist a fixed bearing point that permits him to exert pressures upon the pedals that one who had not tried this simple process would not suppose possible.

In order to be lighted at night and make one's self heard, we have the lantern bell (Fig. 3, No. 7). A belt permits of fixing this sonorous alarm to the handle bar. Upon returning home at night, we have, for fixing the bicycle upright, the support shown in Fig. 3, No. 8, and which is entirely of iron, folds up and may be kept in a closet. If hydrotherapy tempts one, he may, after a spin upon the road, enter the velodouche (Fig. 3, No. 5), which consists of a tub in the center of which is installed a force and suction pump actuated by a pair of pedals, and in which he can pedal under the shower that his feet pour over his head. Finally, if the cyclist desires to carry his bicycle in a railway car on a long journey, he can use the Vincent case (Fig. 4), which is easily handled and may be folded like a portfolio as shown in the figure.

Among the inspirations that cycling has given other industries is the bicycle skate (Fig. 3, No. 10), which consists of two small wheels with hollow rubber tires, connected by a crosspiece of metal upon which are mounted the heel and toe straps. Experiments have been made with these roller skates in the alleys of the Bois de Boulogne. The inventor asserts that it is possible to skate thus, after a little practice, at a speed of nine or ten miles an hour. Let us mention, in conclusion, the ball caster for table legs, shown in Fig. 3, No. 9, and which does away with the tearing of carpets and the scratching and wear of wooden floors, etc. This is an intelligent application of balls, that is especially indicated for beds, pianos and other heavy pieces of furniture.—La Nature.

THE LONDON ENGINEER AND AMERICAN RAILROAD SPEEDS.

THE Engineer, of London, has always doubted the accuracy of the statements regarding the phenomenal fast runs which have occasionally been made in this country. It has a stately, ex cathedra way of rebutting human testimony, however well established, with elaborate theoretical discussions. American officials may take every precaution to secure correct timing of a train between points, but they apparently fail to convince our contemporary that the loads are hauled and the times made. Editorial reference to this matter will be found in the current issue of the SCIENTIFIC AMERICAN, and we publish herewith, as an illustration of the Engineer's favorite methods of debate, a full digest of a letter from Mr. Geo. S. Strong to the Railroad Gazette and The Engineer's editorial criticism of the same. We also publish in full a reply by Mr. Strong addressed to the Editor of the SCIENTIFIC AMERICAN.

To the Editor of the Railroad Gazette:

I was much interested by the article "What High Speed Means," in your issue of January 1. Coming, as it does, from The Engineer, which has at various times made predictions as to the impossible in regard to high speed on railroads, I am not altogether surprised at it. I would like, however, to remind The Engineer that what has already been accomplished may be done again. And in this connection I should like to call attention to two or three cardinal principles in steam engineering that are often overlooked by designers of locomotives which are intended to be very fast and powerful, principles that are being departed from by a number of railroads.

The Engineer speaks of the trial of a locomotive weighing 70 tons with two break vans, and says that everything was done to get up to the highest speed in the least time, and yet only once was seventy-two miles an hour reached in two miles. He believes that he is within the truth in saying that an assumed train of 150 tons cannot get up to sixty miles an hour in less than four miles, and that one mile will be used in coming to a stop. Allow me to compare this with an actual performance with a locomotive in actual service with a train that weighed 450 tons exclusive of engine and tender.

Official record of a run on the Pittsburg, Fort Wayne, and Chicago on June 20, 1887.—Train No. 3 between Fort Wayne and Chicago, 148 miles; train consisting of one baggage car, five coaches, and four Pullmans, ten cars in all; running time, three hours and forty-five minutes, including twenty-three stops, and five slow-ups for bridges. This train made one run between stations, a distance of 9·5 miles, in ten minutes to a second, and another run of 8·7 miles, including one crossing stop, in nine minutes. The train was hauled three miles up a 26 ft. grade, with brakes set on one of the Pullman cars, caused by a brake sticking. The weight of the train was about 450 tons, engine 448, Lehigh Valley Railroad; A. H. Polhemus, road foreman; C. Walton, trainmaster.

How does The Engineer account for these facts if it requires four miles to get up to sixty miles an hour with a 150 ton train?

Another instance: This same engine on the Northern Pacific, on June 25, 1887, pulled a train that weighed 950,000 lb., including engine and tender, from Royalson to Little Falls, a distance of 10·5 miles, in eleven minutes from stop to stop. When doing this she indicated 1,810 horse power and showed a mean effective pressure of 70 lb. at 325 revolutions per minute, 1,300 piston speed.

How do we account for the way this engine picked up these very heavy trains and put them at such high speeds in such short distances? The answer is a very simple one. She had the ability to maintain a very high mean effective pressure on a large, or pair of large, pistons moving at very high piston speed; and this is where the 70 ton locomotive spoken of by The Engineer as not being able to put two vans up to 72 miles an hour short of 2 miles is lacking.

This locomotive had 7 ft. driving wheels and an 18 in. by 24 in. cylinder, and probably a short port, with a very short travel of valve, and could not get at this speed more than about 35 lb. mean effective pressure; and owing to her 7 ft. driving wheels could not get more than 960 ft. piston travel when moving at sixty miles an hour. This would give her less than 600 horse power, while the other engine indicated 1,810 horse power.

An ideal condition of fast train service is a locomotive that can make the schedule whatever it may be over the average grades, as fast up the grade as it is safe for her to run down them; and on some mountain roads this is the only safe rule to follow. To be able to accomplish this one must have all of the following qualities:

(1) A well maintained high mean effective pressure; (2) high piston speed; (3) enough adhesion, or tractive force, to do the work on grades, and in starting trains with as little slipping as possible.

This involves the use of a boiler of large heating surface and large grate area, capable of carrying high pressure safely, and the large cylinder power with a valve and valve gear capable of giving the high mean effective pressure at the high piston speeds and with weight enough on the driving wheels to do the work without slipping or without overloading the tracks and bridges, which may require six-coupled engines, with driving wheels not so large as to reduce piston speed. Such an engine, properly balanced, will make that which The Engineer calls one of the impossible things an easy task.

GEORGE S. STRONG.

THE ENGINEER'S EDITORIAL CRITICISM.

In another page we reprint from the Railroad Gazette a characteristic letter from the pen of Mr. George S. Strong, a well-known American engineer, and the inventor of a locomotive boiler about which a great deal was said at one time. Mr. Strong, it will be seen, maintains that certain phenomenal runs were really made on the Pittsburg, Fort Wayne and Chicago Railroad as far back as June 20, 1887, and he asks how does The Engineer account for these runs "if it requires four miles to get up to sixty miles an hour with a 150 ton train"? Our answer is very simple. The runs in question never were made on a level; and we never said that it took four miles to get sixty miles an hour with a 150 ton train. We did say that on a level not one of the trains tested during the classical brake trials at Trent attained a velocity of sixty miles an hour with a three mile run in which to get up speed. Experience convinces us that all statements concerning phenomenal runs between points close together, from start to stop, are to be regarded with suspicion, because they imply, and of necessity imply, the expenditure of enormous power—a power, indeed, which the locomotive cannot exert. As the truth does not appear to be as fully realized as is desirable, it is worth while to explain what has to be done when a train is brought from a state of rest to a speed of say sixty miles an hour, and then brought to rest again. It is not necessary to give all the calculations in detail.

The energy stored in a train running at sixty miles an hour, or 88 ft. per second, is precisely the same as if it had fallen down a precipice 120 ft. high. Each ton of train represents 120 foot-tons of energy. In other words, a tractive effort equal to the whole weight of the train would have to be exerted in order so to accelerate it that when 120 ft. from the starting point it may have a speed of sixty miles an hour. The distance to be traversed increases in the inverse ratio of the pull; that is to say, the less the pull the greater the distance. If the pull was one-tenth of the load, the distance would be $120 \times 10 = 1,200$ ft., and so on. Let us suppose that the gross weight of a train, including engine and tender, is 200 tons, and that the tractive effort is five tons; then neglecting the frictional resistance of the train, which is supposed to be running on a level piece of road, we have an effort equal to one-fortieth of the gross weight. Then the shortest distance in which a speed of 88 ft. per second can be attained is $40 \times 120 = 4,800$ ft. The proof of this is very easy. We have seen that the stored work in the train is $120 \times 200 = 24,000$ foot-tons, but $5 \times 4,800 = 24,000$. The average speed of the train, starting from rest, during the period of acceleration, will be 44 ft. per second, or half the final speed, and $\frac{4800}{44} = 109$, which is the number of seconds representing the period of acceleration, or 1·816 minutes.

Let us now consider what the locomotive has to do. A pull of five tons, or 11,200 lb., exerted at the velocity of 44 ft. per second is equivalent to very nearly 900 effective horse power. But this is not all. The frictional resistance of the train we have neglected hitherto, yet at an average speed of 30 miles an hour it cannot be less than 10 lb. a ton, or for 200 tons 2,000 lb.; adding this to the 11,200 lb. already named we have 13,200 lb.; consequently our locomotive must exert not 900 horse power, but 1,056 horse power. This, however, is not all. The figures give only the average power. At the moment 60 miles an hour is attained the engine must be exerting twice the average power, or over 2,000 horse power, for at that time we had an effort of 13,200 lb. moving at the rate of 88 ft. per second. Even now we have not covered all the ground, for nothing has been said concerning the difference between indicated and effective horse power. We shall not be over the mark, we think, if we say that during the last few seconds the diagrams would show that the engine was indicating considerably over 2,000 horse power. Let us assume an engine with 20 in. cylinders, 24 in. stroke, and driving wheels 5 ft. 10 in. in diameter. By Pambour's formula the tractive effort of such an engine is equal to 137 lb. per pound of average effective pressure in the cylinder. We have seen that the total tractive effort must be at least 13,200 lb., and this divided by 137 gives 96·3 lb. as the average effective pressure that must be carried. Our readers can draw their own deductions as to the possibility of all this. It may be said, of course, that it is quite unnecessary to postulate such conditions, because no one wants to get up a speed of 60 miles an hour in, say, two minutes, or a little less. But let us consider then what the statement that a train ran, say, 10 miles in 10 minutes, start to stop on a level, means. We have to deduct first two minutes and one mile for the start. This leaves us 9 miles to be traversed in 8 minutes, and if we take off half a mile and one minute for pulling up, we have 8·5 miles to be run in 7 minutes, or, say, at the rate of 72 miles an hour. If the period of acceleration is increased to reduce the horse power at the start, it will be seen that matters are not much improved. If our readers will turn to an article which appeared in our impression for October 23, 1896, page 407, they will find this question of high speeds on short runs fully dealt with from a somewhat different point of view, in connection with certain train book times, adduced in connection with the Preston catastrophe.

Let us now, in the light of these calculations, examine one or two of Mr. Strong's statements. A train, he says, weighing 424 English tons, including engine and tender, was hauled a distance of 10·5 miles in eleven minutes from start to stop. We take it for granted the line was level; Mr. Strong gives us no intimation that it was not. The speed must have exceeded sixty miles an hour. To get sixty miles, however—the figure on which Mr. Strong dwells—in two minutes, the tractive effort must have been 9·63 tons, because the energy accumulated in the train when it had run one mile was 50,880 foot tons. But the frictional resistance of the train could not have been less than 4,240 lb., even making most liberal allowances. We find that the gross tractive effort necessary to get the speed up to sixty miles an hour in one mile and two minutes must have been at least ten tons, and that ten tons effort at the rails must have been maintained without abatement over the whole mile, and for the whole two minutes. For an engine with 20 in. cylinders, 24 in. stroke, and 5 ft. driving wheels, that means an average effective pressure of 160 lb. per square inch in the cylinder, throughout the stroke—rather a large pressure for sixty miles an hour. We are told by Mr. Strong that the engine indicated 1810 horse power. As a fact, it must have indicated on the average during the run of a mile nearly 3600 horse power, and during the last few seconds about 7,000 horse power. The run was 10·5 miles. Deducting half a mile and one minute for the stop, and two minutes and one mile for the start, we have left nine miles to be run in 8 minutes. Mr. Strong may say that we have not stated the facts accurately. Let us suppose, then, that four minutes and two miles were expended in accelerating the train; the power required would then be reduced to about Mr. Strong's figures; but then we have left only six minutes to traverse a distance of eight miles. It is clear, therefore, that the speed must have been eighty miles an hour. It is not necessary, we think, to give figures to prove that 1810 horse power would not have sufficed. Another statement that a train, weighing with the engine 450 tons, made a run of 8·7 miles in nine minutes, including one crossing stop, is not more worthy of credence.

We have often heard it said that although in starting a train first a great dead pull is necessary, subsequently less and less tractive force is required. Those who argue in this way justify Dr. Lodge's statement that engineers know nothing about acceleration. The figures we have given contemplate a continuous and equable increase in the rate of the train. In practice no doubt this equable effort cannot be brought to bear, for reasons that should be sufficiently obvious. But if the effort diminishes as the speed augments, the engine being able to pull less at high than low speeds, then the initial effort must be proportionately augmented,

and in the case mentioned by Mr. Strong must have much exceeded ten tons. We think our readers will agree with us that there is much that demands explanation in Mr. Strong's communication. Thus, for example, the runs may have been down hill, but in that case it is clear that all the credit must not be given to the locomotive. We do not believe that any engine exists now, or ever has existed, that could have accomplished what Mr. Strong has been led to believe—no doubt without due examination of the figures—has been done. Either the weights, or the times, or the distances, or all three, have been given inaccurately. Mr. Strong, we are glad to see, attaches some importance to what we say. We shall be glad to have his version of what took place; the highest velocity attained, and the time taken in attaining it, being all-important.

New York City, February 20, 1897.

To the Editor Scientific American,
New York, N. Y.

Dear Sir: I notice that in a recent editorial The Engineer, of London, has questioned the accuracy of the records of certain fast runs made by the Strong locomotive. In reply I would say briefly that The Engineer has assumed as the basis of its calculations certain facts which are not proved and has figured from these facts, and in so doing has arrived at conclusions which are entirely at variance with the facts as actually demonstrated: moreover, its train resistances, worked out in the manner in which it has worked them out, do not correspond with the data in regard to train resistances as found by experiments with dynamometer cars, nor with the generally accepted theories in regard to train resistances for American rolling stock now in use in this country.

The Engineer also assumes a number of other things which are purely assumptions and goes entirely beyond the amount of power that actually is required to do the work that was done on these runs. In dynamometer tests that we have made, we find that in starting a train of say seven cars, the necessary pull runs up with a surge on the diagram to something over 20,000 lb. This pressure drops back almost immediately, or within ¼ of a minute, to about 1,000 lb. per car, at which it remains until the train is under full speed, and the increased h. p. indicated by the engine is due to increased foot travel of this lesser amount of pressure.

We already know that an engine with a dead pull, where she is unable to move her train, or start or slip her wheels, would not be indicating any h. p., but that her h. p. is due entirely to foot pounds travel of a given pressure.

As regards the possibilities of this locomotive to do the work that was necessary in making these runs, I would say that, on the Fort Wayne road, a few days before this run was made which I have mentioned, we were pulling a train from Pittsburg west, and in leaving the Ohio River Valley we struck a grade of 50 ft. to the mile which is 16 miles long, and when we reached the foot of this grade, the Pennsylvania engineer who was running the engine made the remark that he "was going to run this engine out of steam if it was possible," and dropped the reverse lever forward so that the engine was cutting off at half stroke, pulling the throttle wide open. He had 170 lb. pressure when he made this remark, and at the top of the grade he had the same pressure, but was running the engine out of water, although he was using two injectors, one of which had a capacity of 3,000 gallons and another of 3,500 gallons. He remarked that he "could not run her out of steam," but that he "could run her out of water." He had ascended the 16 miles of 50 ft. grade in 20 minutes, with a train of 450 tons including engine. If we assume that this engine was giving a h. p. on 22 lb. of water, which she had demonstrated her ability to do on previous tests, this would have given her on this occasion 3,000 h. p.

In another place, the editor of The Engineer speaks of 10 tons of drawbar pull as being necessary to accelerate the weight of train mentioned. In answer to this, I would say that on a run made by this engine between St. Paul and Minneapolis, when having a boiler pressure of 175 lb., she gave a mean pressure of 150 lb. when pulling fourteen cars up an 86 foot grade at a speed of 20 miles an hour, and that this represented a drawbar pull of 23,500, and that the resistance of this train due to the lift of the weight of the train at this speed was 14,000 lb., while the other or remaining pull was due to frictional resistance of the train. I would remark in connection with this that this locomotive, owing to its peculiar boiler construction as indicated by the test above mentioned, had the ability to maintain its boiler pressure while following 75 per cent. of the piston travel, and that she did not exhaust until the last inch travel of the piston.

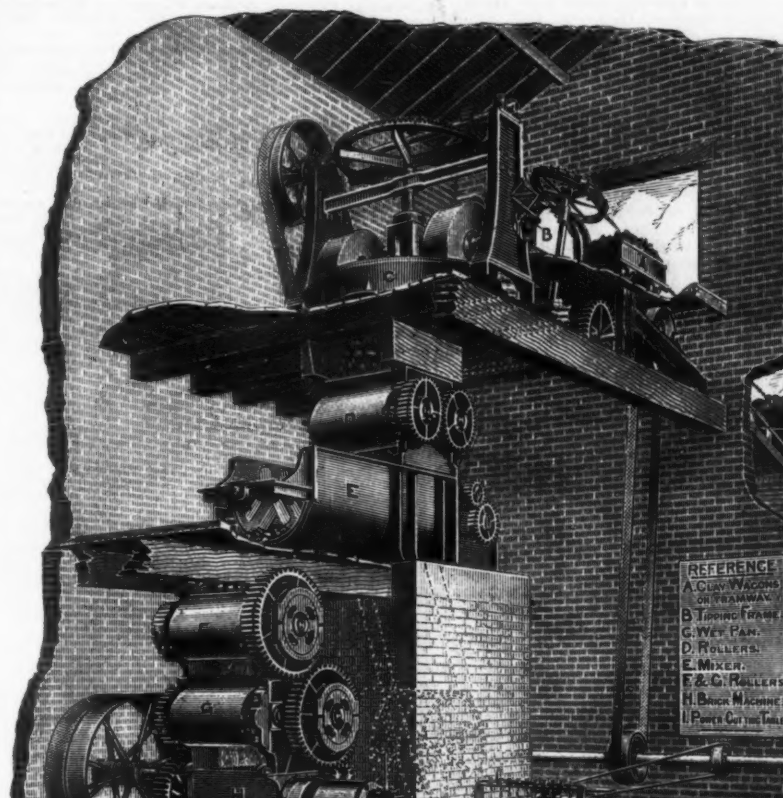
The large area of admission, by reason of the gridiron valves with their very large port area, which was equal to 25½ square inches, enabled her to get within 3 lb. of boiler pressure as initial pressure, and to get rid of the exhaust almost instantly, so that what ordinary locomotives would do is no precedent for what this engine could do; moreover, her mean effective pressures, shown at these high piston speeds, are just about double what have been shown on engines of similar boiler pressures having the ordinary link motion with the D valve. George S. Strong.

PROSPECTIVE RAILWAY ROUTES IN AFRICA.

In describing, before the geographical section of the British Association the probable railroad routes in Africa, Major Leonard Darwin, president of the section, mentioned the routes up the Nile and into parts of the central Soudan as among the most important, says the Popular Science Monthly. In the Nile route, the river itself would afford a large part of the medium of communication; but the region of the cataracts, covering several hundred miles, would have to be spanned by a railway connecting the lower river with Berber. Above Berber is a navigable waterway at high Nile for fourteen hundred miles to the Fels rapids, besides between four hundred and six hundred miles on the Blue Nile and the Bahr-el-Gazal. There is, perhaps, only one other place in Africa where an equal expenditure would open up such a large tract of country as between Suakim and Berber. Two routes for railways from the coast to the Victoria Nyanza have been proposed, one running through the British and the other through the German sphere of influence. The German route would be the shorter of the two; but there is some reason to think that the British line will open up more country east of the lake which will be suitable for prolonged residence by white men. A line from the south end of Lake Tanganyika to the northern end of Lake Nyassa and thence to the coast would open up a vast extent of territory, and would, especially if eventually connected with the Victoria Nyanza, be more valuable than any other line in Africa in putting an end to the slave trade. On the west coast the Congo points to the most important line of communication. After a hundred and fifty miles of navigable waterway we come to two hundred miles of rapids, along which a hundred and seventeen miles of rails are already laid. Then on entering Stanley Pool there are, according to the Belgian estimates, seven thousand miles of waterway. If all the representations are correct, there is no place in all Africa where two hundred miles of railway may be expected to produce such marked results. Another region of great promise is that of the Niger, but the political conditions of the country—it lying on the border land between the Mohammedan and the pagan tribes—make the early execution of railways somewhat problematical. Formidable mountain ranges being few, the chief impediments to railway construction in Africa are the drifting sands, wide tracts of rocky country, the dampness of the forest causing rapid decay of material, and the deadly nature of the climate.

A BRICK MAKING PLANT, YOUGHAL.

The accompanying engraving illustrates a brick making plant, constructed by Messrs. Bennet & Sayer, engineers, Derby, for the Youghal Brick Company, Youghal, County Cork. The clay is brought into the machine room by small wagons worked by an endless chain and gravity, a self-acting switch transferring the clay wagons from the up to the down line of rails. The wagons run on to a tipping frame, and empty their contents into the wet grinding, which is 8 feet 6 inches in diameter. From thence it finds its way into a mill with rolls 2 feet 6 inches in diameter. Thence it passes into a mixer or pugger, which is 8 feet long and 2 feet 10 inches wide inside. Afterward the clay is passed through a second and third roller mills, with rolls 2 feet in diameter, and finally into a No. 3 brick machine. The bricks are cut by a power-driven wire table. The output is about 25,000 bricks per day.—The Engineer.



PLASTIC BRICK MAKING PLANT, YOUGHAL.

STEVENS INSTITUTE OF TECHNOLOGY.

TWENTY-FIFTH ANNIVERSARY.

By William H. Hale.

The great expansion and growth of schools of applied science is a feature of the age, and notable among them is the Stevens Institute of Technology, which reaches its quarter century mark with a record to be proud of.

The Stevens family, who founded and endowed it, have been notable as engineers during almost or quite the entire life of the republic. As early as 1790, John Stevens, the greatest engineer of his time, gave an impetus to the patent system of the country by petitioning Congress to pass a law establishing such a system; and two years later, having succeeded in securing such legislation, he himself obtained a patent for navigating boats by steam power. He anticipated Fulton by several years in steamboat navigation. He and his sons, Robert L. and Edwin A. Stevens, also led in applying steam to railroad locomotion. As early as 1812 he urged the construction of a railroad along the line where the Erie canal was afterward built, and in 1815 he obtained the first railroad charter granted in America, for a road from Trenton to New Brunswick, and in 1823 he secured from the legislature of Pennsylvania the charter of the Pennsylvania Railroad Company.

The Stevens family are best known to this generation as inventors of the Stevens battery, and constructors of ironclad vessels, which played such a momentous part in the war of the rebellion. It is not generally known, however, that their experiments with armor go back nearly to the beginning of the century, and that in 1812 John Stevens proposed to construct a circular armored vessel rotated by steam and by which her guns could be quickly trained. Had this been done at the time, the use of such a vessel in the war then in progress would have hastened, for half a century, the retirement of wooden or unarmored vessels from naval service.

The anniversary exercises of the Institute began on Thursday evening, February 18, with a banquet at the Hotel Waldorf, in New York City, held in the new ball room, the scene of the Bradley Martin ball a week before. S. B. Dod, one of the trustees, presided, and among the after dinner speakers ex-mayor Abram S. Hewitt gave interesting reminiscences of the Stevens family, every one of whom he had seen, and he supposed he was the only person who ever had seen them all. Commodore Melville, chief of steam engineering of the United States navy, eulogized the work of the Stevenses, and said that John Stevens must have foreseen that naval vessels would develop into fighting machines rather than into fighting ships. He attributed the naval supremacy of Britannia to "Watt, Fulton, Stevens, and Ericsson." The predominance which this nation lost in the transition from the sail to the steam age, he said, would be reclaimed as much by the engineer as by the sailor. President Henry Morton read a poem on the Stevens family; and he presented the Institute one thousand shares of Texas Pacific Railroad stock, with \$9,250, as a contribution toward the proposed alumni hall. Andrew Carnegie, Prof. Watkins and Bishop Potter were also among the speakers.

On Friday, February 19, an exhibition of apparatus, photographs, etc., was held at the Institute building in Hoboken. Many ingenious appliances were shown, invented, and in some cases constructed, by graduates and students. A registering pyrometer, with ingenious device for analyzing the air of a furnace and measuring and recording the proportion of CO_2 present, was a sample of several now in constant use by Mr. Carnegie. An array of Pintsch lights was shown with several improved features. A hard rubber pump for acids looked just like iron, but the difference was at once detected on touching it. A wire drawing machine was in operation, in which the wire was drawn continuously through twenty or more holes of progressive smallness, going into the machine a very large wire and coming out a very fine one. An electrical furnace in operation was making calcium carbide, which the exhibitor then put in water to cause the evolution of acetylene gas and burned the gas with a brilliant flame. The X ray exhibit was most crowded, and excellent results were produced by using a rapidly revolving wheel with points rotated against a brush of fine copper wire, while a strong air blast blew the sparks away, so as to make and break connection rapidly. Many other interesting objects were presented.

The Stevens family gave a reception on the same

afternoon at their mansion at Stevens Point, adjoining the Institute, and commanding a superb view of the North River and New York City. A promenade ball in the evening closed the festivities.

The Stevens Institute has from the beginning been presided over by Dr. Henry Morton. The faculty of eight has increased to twenty-two, all the additions being from students of the Institute. Some of the well known professors are: A. M. Mayer, De Volson Wood, J. Burkitt Webb, James E. Denton. R. H. Thurston, formerly there, is now director of Sibley College, at Cornell University.

ALUMINUM IN 1896.

THE production of aluminum in the United States during the year 1896 was 1,300,000 lb. (650 short tons), as against 900,000 lb. (450 short tons) in 1895, showing a gain of 400,000 lb. (200 short tons), or 44 per cent., says the Engineering and Mining Journal. As has been the case for several years past the entire domestic output came from a single producer, the Pittsburg Reduction Company, whose plant at Niagara Falls has been enlarged, and has been working at nearly full capacity. The advantages of this location are very great for comparatively cheap electric power, and the company for this and other reasons has been in complete control of the domestic market. Bauxite is chiefly used as raw material, the company controlling the Georgia Bauxite Company, which in 1894 leased for a term of years the bauxite deposits on the Barnsley estate, in Bartow County, Ga., and began shipments in 1895. The mineral is sent to the works of the Pennsylvania Salt Company, at Natrona, Pa., where it is worked up into alumina, and the fluorides of aluminum and sodium used in the reduction process. The metal produced at the Niagara Falls plant is manufactured into sheets, bars, rods, wire, tubes, angles, channels and other structural forms, and into small articles, at the company's original works at New Kensington, Pa.

The consumption is divided on about the same lines as formerly, the larger part of the increased demand going into alloys, while the pure, or nearly pure, metal is mostly made up into such small articles as household utensils, implements, instruments, fancy goods, etc. Aluminum bronze and nickel aluminum are in good favor. The Mitis process of making malleable iron castings with small quantities of aluminum alloy has not apparently fulfilled expectations as to the demand for the metal. For some time the French government has been interested in the application of aluminum for military and naval purposes, as in the construction of torpedo boats, but no definite information as to results is available. Some aluminum has been used in making bicycles. While thus far the consumption has fairly kept up with the producing capacity of the American and foreign works, it does not appear probable that there is to be any great expansion of business at present prices. For scientific instruments and the usual run of small goods made of pure aluminum, the metal is perhaps cheap enough now, but this field has already been pretty well exploited. For use on a large scale, as for structural purposes in general, it has to compete with cheaper materials. Of course there are always uses, as for warlike purposes, in which the cost might be a secondary matter in view of the specially advantageous properties of aluminum, but thus far such utilizations have been usually deferred for the future.

The following table shows the production of aluminum in the United States for six years, the figures including the aluminum used in alloys:

Year.	Production. Pounds.	Value.
1891	168,075	$126,056
1892	295,000	191,750
1893	312,000	202,800
1894	817,600	490,560
1895	900,000	495,000
1896	1,300,000	520,000

From this it appears that the output has been steadily increasing, without setback in any one year, notwithstanding depression in general business; but the values have not quite kept pace with the quantities. For 1896 the average price is taken at 40c. per pound.

The production in the United States has been somewhat over one-third that of the world. The principal European producer is the Aluminum Industrie Gesellschaft, with works at Neuhausen, Switzerland, and controlling the Société Electro-Metallurgique de France, with works at Froges, in France. In 1895 the Neuhausen works turned out about 650,000 kgs. and the Froges works about 100,000 kgs. The British Aluminum Company, using Irish bauxite, has been making extensive preparations and will now appear as a producer. The total output of aluminum in the world during 1896 has not yet been reported, but in 1895 it was approximately 1,150 metric tons (2,535,290 lb., or 1,268 short tons).

Prices.—At the beginning of 1896 the American scale was as follows: No. 1, 98 per cent. pure, ingots for milling, 50c. to 55c., No. 1, ingots for remelting, 48c. to 53c., No. 2, 94 per cent pure, ingots for remelting, 42c. to 50c., the range in each case depending on quantity. These rates held until July, when we quoted No. 2, 94 per cent. pure, ingots for remelting at 38c. to 42c., and ingots from scrap at 35c. to 40c., No. 1 grade as before. In November the Pittsburg Reduction Company announced a reduction in prices of from 5c. on the lower grades to 11c. on the higher, the new schedule (which has been maintained to the close of the year) standing thus: No. 1 (guaranteed over 98 p.c. pure) ingots for remelting, 42c. in small lots, 39c. in 100 lb. lots, 37c. in ton lots; No. 2 (guaranteed over 90 per cent. pure with no injurious impurities) ingots for remelting, 34c. in small lots, 33c. in 100 lb. lots, 31c. in ton lots; nickel aluminum casting metal (pure aluminum alloyed with less than 10 per cent. nickel and other hardening ingredients), 40c. in small lots, 38c. in 100 lb. lots, 35c. in ton lots; special casting alloy (containing over 80 per cent. pure aluminum, used in place of brass), 35c. in small lots, 30c. in 100 lb. lots, 27c. in ton lots; castings, 45c. per pound, upward, and special rates for bars, rods, shapes, etc.

Lord Kelvin and Prof. Simon Newcomb have been elected honorary members of the St. Petersburg Academy of Science.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

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